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ABSTRACT

Eight energy education activities are provided. Each activity includes an overview, a brief summary, lists of objectives and materials needed, teacher's notes, and student materials. The activities focus on: (1) using social studies skills to understand Minnesota energy data and to clarify and understand some Minnesota energy issues; (2) giving reactions to 20 energy statements about Minnesota; (3) collecting and evaluating information on some problems and potentials of Minnesota's alternative energy sources (solar energy, petroleum, natural gas, hydropower, wind energy, coal, biomass, nuclear energy, propane, and district heating); (4) comparing energy costs of low income and non-low income households; (5) examining Minnesota's energy future using a modified Delphi technique; (6) writing a description of a possible energy future which explores the sequences of events leading to a future state; (7) reading and reacting to information about the coal severance tax and its impact on Minnesota; and (8) examining the comparative costs of conservation and the costs of energy from other sources. (JN)

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MINNESOTA AND ENERGY

SE044652

MINNESOTA DEPARTMENT OF EDUCATION
MINNESOTA DEPARTMENT OF ENERGY, PLANNING AND DEVELOPMENT
MINNESOTA ENVIRONMENTAL EDUCATION BOARD
1982

Minnesota Energy Data

OVERVIEW Minnesota may choose to deal with future rising energy prices in many ways. In order to carefully examine the effects of different responses to rising energy prices the Energy Division, Minnesota Department of Energy, Planning and Development, developed three scenarios that characterize three distinct potential paths Minnesota might follow. Scenarios are not forecasts, rather they are sets of hypothetical conditions and assumptions combined to represent various possible approaches to the energy problem. The first scenario, the Current Market Scenario, is structured to reflect the current way Minnesota households respond to and cope with rising energy prices. It shows the implications of continued reliance on the existing private energy market. The second scenario is called the Rapid Transition Scenario. This scenario attempts to quantify the response to rising energy prices that might occur if some of the current imperfections in the energy supply market were reduced. In this scenario, the economy is in transition to more efficient use of conservation and alternative energy. Finally, the Free Market Scenario represents the type and level of energy consumption that would occur in Minnesota if all consumers faced the true replacement cost of the energy they consumed and all barriers to free entry and full competition between conservation and alternatives and traditional fuels were eliminated. In this ideal market, conservation, alternatives and traditional fuels compete freely in the energy marketplace.

ACTIVITY SUMMARY

Students use social studies skills to understand Minnesota Energy data. The major purpose is to help clarify and understand some Minnesota energy issues.

AS A RESULT OF DOING THIS WORK WE HOPE STUDENTS WILL:

* identify some of the major problems and issues about energy in Minnesota
* identify and locate sources of information and evaluate the reliability and relevance of these sources
* develop questions appropriate for obtaining information from sources
* evaluate the quality of available information
* organize, analyze, interpret and synthesize information obtained from various sources
* identify ways of reducing energy consumption
* identify problems with reducing consumption.

MATERIALS

For each student
3 Student Sheets

TEACHER NOTES

1. Make copies of the Student Sheets.

2. Hand out Student Sheet I.

   The current market scenario was structured to show the implications of continued reliance on the existing private energy market. In this scenario the pricing structure of natural gas and electricity is assumed to keep its current form. That is, consumers pay the average price rather than the replacement cost. The average cost is lower than the replacement cost because it includes less expensive, older sources of energy, like natural gas from shallow wells, as well as the more expensive replacement natural gas, like Alaskan natural gas. In contrast, replacement cost is the true cost of replacing the last unit of energy consumed. Because the price of energy determines both demand for and supply of that energy form, the lower, average cost pricing structure encourages reliance on those energy types.

   The Energy Division expects natural gas to be fully decontrolled by 1986. This assumption is included in the Current Market scenario. As a result, consumers will face the replacement cost of natural gas beginning in 1986. Electricity, however, is priced on an average cost basis throughout the century in this scenario. Petroleum prices were decontrolled in early 1981, and as a result, consumers currently pay the replacement cost for petroleum products.

   Assumptions about the extent to which Minnesotan's use conservation and alternative energy sources and the degree to which an alternative energy industry is developed in the state are also keys to the outcomes of the various scenarios. In the current market scenario the penetration of conservation and alternative energy techniques is assumed to occur at historically-observed rates for other energy technologies, like natural gas. However, the current level of conservation and development of alternative energy is significantly below the level predicted given current prices and historical rates of penetration. This difference is considered to represent barriers existing in the market such as attitudes, and knowledge about conservation and alternative energy, and financial barriers like the current high real rates of interest. This level of barrier is considered to continue, undiminished throughout the century. Thus, although the <u>rate</u> of penetration is the same as would be expected given our experience with past energy technologies, the level of penetration is lower.

   The current market scenario represents a <u>private</u> market economy, but not a <u>perfect</u> market economy. It is intended to capture the current climate for implementation of new technologies and reflect the current forces at play in our economy.

   Be sure to discuss the questions on Student Sheet I with your class.

3. Hand out Student Sheet II.

The Rapid Transition Scenario depicts the implications of responding to rising energy prices with accelerated use of conservation and alternative energy resources in Minnesota. It is assumed in this scenario that some, but not all, barriers to conservation and alternative energy development are removed. The assumptions about the level and growth of prices in this scenario are identical to those used in the Current Market Scenario. Natural gas customers will face the average cost of natural gas until 1986, when decontrol will be finalized. For the remainder of the century natural gas will be priced at the replacement cost. Electricity is priced at average cost and petroleum at replacement cost throughout the forecast period.

In this scenario, the economy is in transition to more efficient use of conservation and alternative energy. Some of the barriers to full use of alternatives and conservation evidenced in the Current Market Scenario and reduced, presumably, as a result of changing attitudes and programs initiated by the public and private sectors. It is not, however, a perfect economy and, as such, alternative energy and conservation do not penetrate to the degree that would be expected given their price and historical rates of penetration of other energy technologies.

Discuss student responses to the questions on the data sheet.

4. Hand out Student Sheet III.

This scenario shows the implications of an ideal energy market, unfettered by the barriers that now hamper the use of conservation and alternatives in Minnesota. In this scenario, conservation, alternatives and traditional fuels compete freely in the energy marketplace. If the costs of all three are equal, then they will each claim an equal share of energy demand. If the cost of one is declining, then it will gradually claim a larger and larger share of the market. Thus, the market imperfections observed in the previous scenarios caused by such things as a lack of knowledge and tax disincentives are corrected, either by public or private action.

Replacement cost, the actual cost to supply a new unit of energy for the last unit of energy consumed, determines the supply and demand for all fuels in this scenario. Thus, the higher replacement price of natural gas is used in the period 1981-1985 and for electricity for the entire forecast period (1981-2000). The replacement cost for electricity is considered to be cost per kWh of building a new coal fire power plant.

Be sure to discuss the questions on Student Sheet III with your class.

WORDS AFTER

1. What do these three pieces of evidence mean?
2. How are the three pieces of evidence related to each other?
3. How are the three pieces of evidence similar to one another? Different?

4. What trends are shown in the data? What should you do with what you know? What action should we take?

5. Would you describe the information on these graphs as:

   a. technical or nontechnical (Circle one)
   b. impersonal or personal (Circle one)
   c. specific or general (Circle one)
   d. accurate or inaccurate (Circle one)
   e. balanced or unbalanced (Circle one)
   f. one view of Minnesota's energy picture or more than one view of Minnesota's energy picture (Circle one).

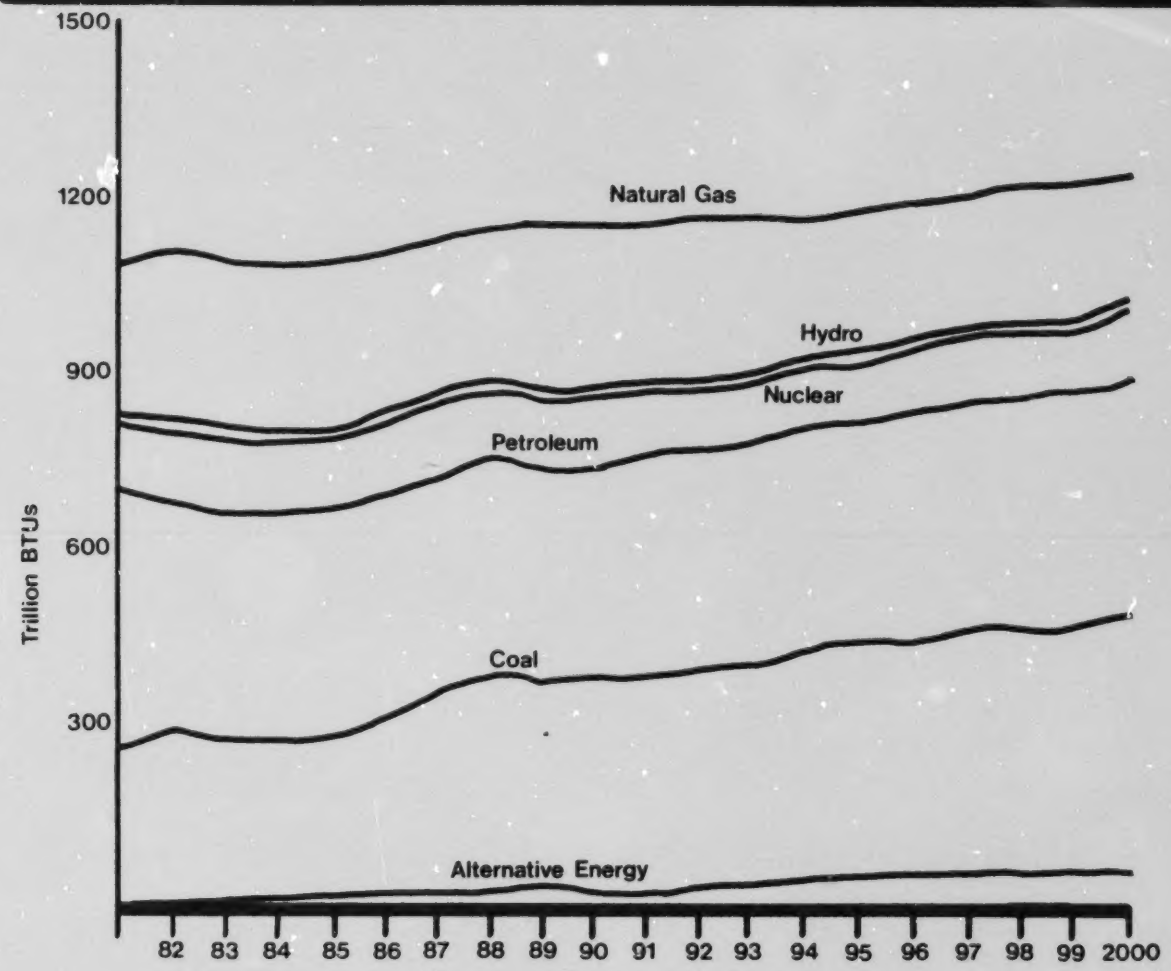
   Ask students reasons for their choices.

6. Minnesota may choose to deal with future rising energy prices in many ways. Of the three distinct potential paths Minnesota might follow, which one do you prefer? What are some reasons for your choice?

7. The data you examined are from the Energy Division, Minnesota Department of Energy, Planning and Development. Does this mean: 1) That, it's so! This is the way Minnesota's energy picture is; 2) This is all the information available on Minnesota's energy future; 3) It's a point-of-view based on information, data interpretation, written by people rather than the government?

   Discuss these responses with your students in the context of balanced, fair, and untainted data/data interpretation.

MINNESOTA ENERGY DATA: STUDENT SHEET I



ENERGY MAKEUP OF MINNESOTA'S FUEL CONSUMPTION: CURRENT MARKET SCENARIO

SOURCE: Energy Division, Minnesota Department of Energy, Planning and Development, 1982

1. What do you notice about this graph? Jot down some things: _____

_____

_____

2. How is energy measured on this graph? _____

3. What is the title of the graph? _____

_____

4. What is the source of the data? _____

5. How reliable is the source? _____

What evidence are you using? _____

What might be a less reliable source? _____

What evidence are you using? _____

6. What does the graph illustrate? _____

7. Is the graph a statement of fact or opinion? _____

What evidence are you using? _____

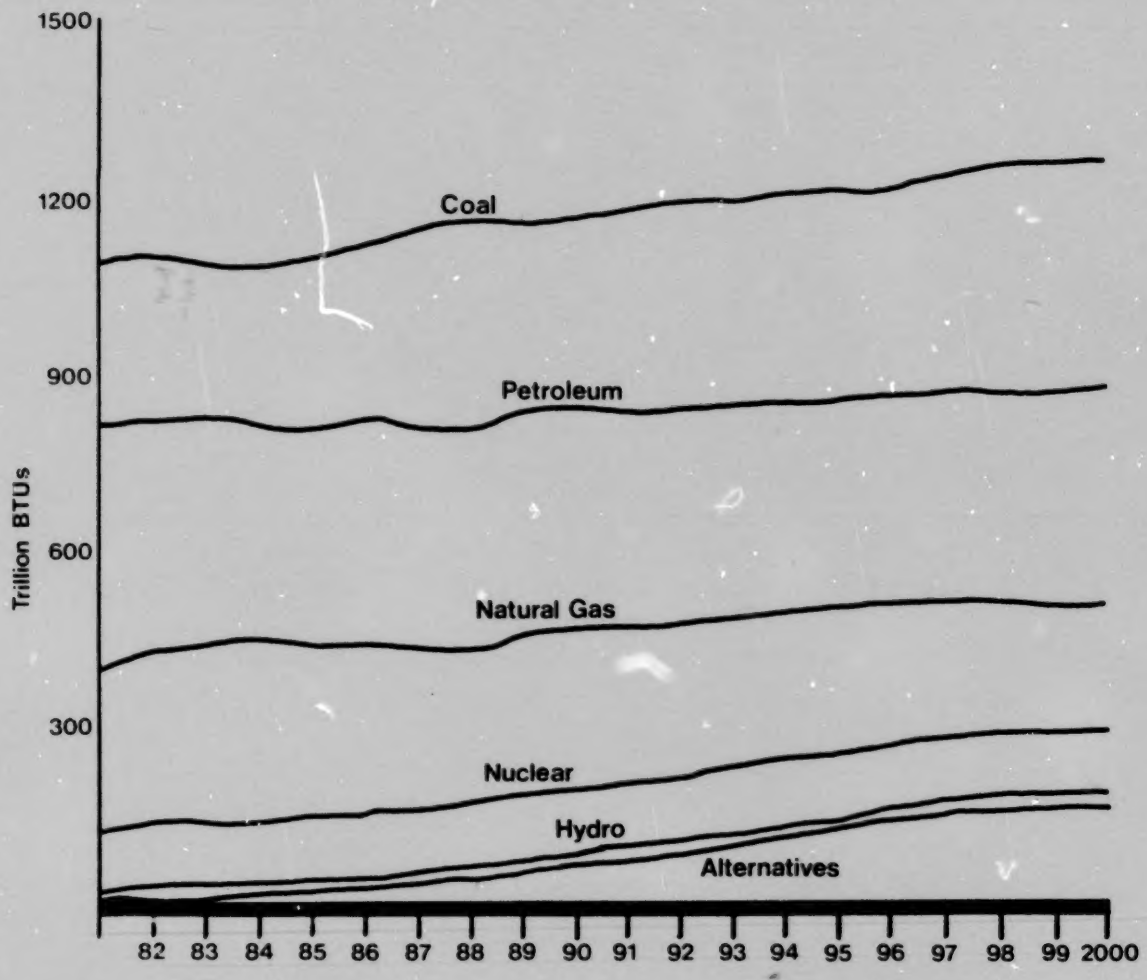
8. What percent of Minnesota's total energy needs are provided by alternative energy sources in the year 2000?

How old will you be then? _____

9. What are some reasons alternative energy development might proceed in the way shown on this graph? _____

10. According to the graph what happens to Minnesota's traditional fuel consumption?

Does this make Minnesota more/less (circle one) energy dependent?



ENERGY MAKEUP OF MINNESOTA'S FUEL CONSUMPTION: RAPID TRANSITION SCENARIO

SOURCE: Energy Division, Minnesota Department of Energy, Planning and Development, 1982

1. What do you notice about this graph? Jot down some things: _____

_____

_____

2. What does the graph illustrate? _____

3. How is energy use measured on this graph? _____

4. Does this graph represent a solution to the dilemma posed on Student Sheet I?

   _____ What evidence are you using? _____

   _____

5. According to this graph, alternative energy resources can supply approximately ____ % of our energy needs by the year 2000.

6. Describe the consumption of traditional fuels this graph shows. _____

   _____

   Does consumption increase continuously? _____

   _____

7. What is the biggest difference between this graph and the graph in Student Sheet I?

   _____

8. What must happen to make events described in this forecast come true?

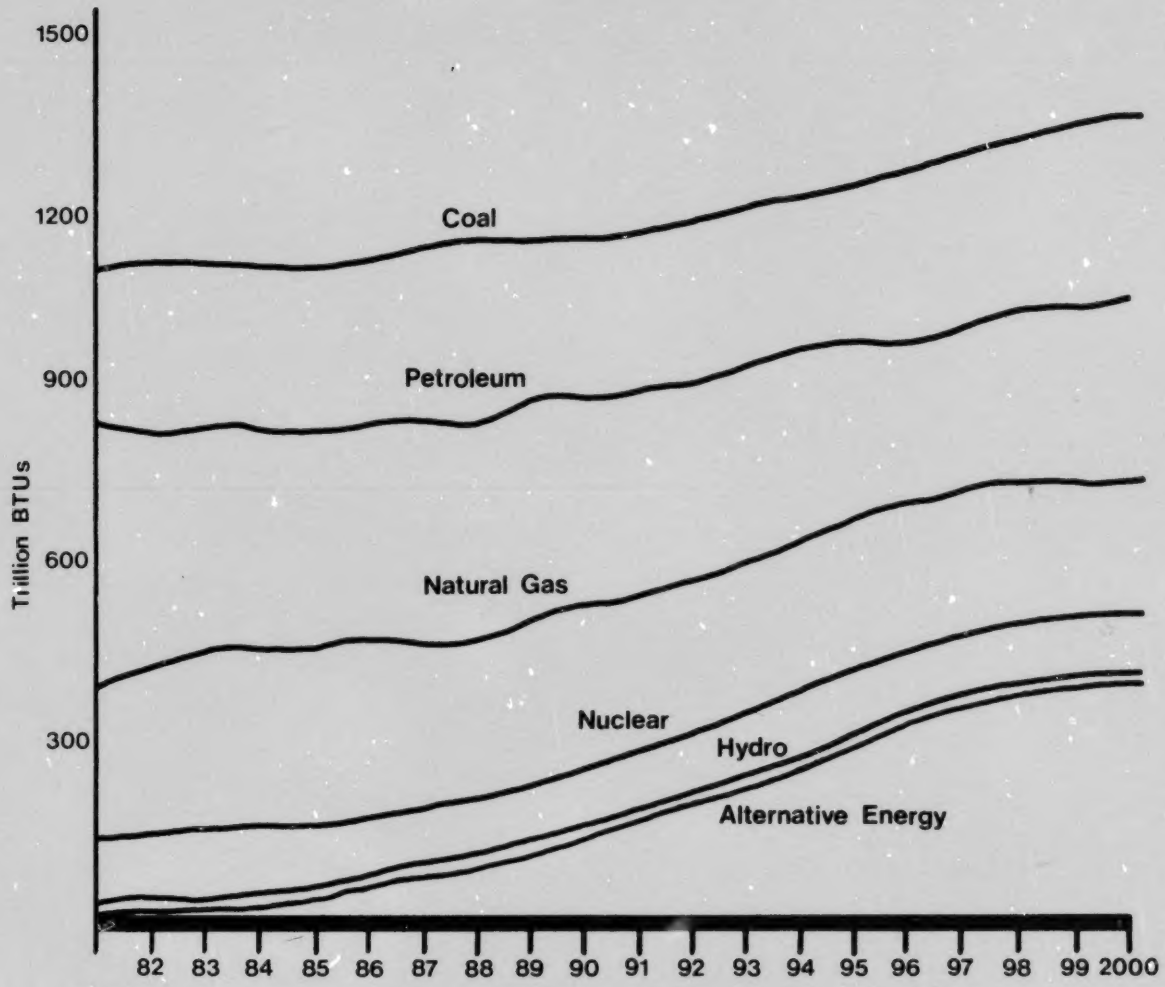
   _____

9. In your own words, what does this graph mean? _____

   _____

   _____

   _____



ENERGY MAKEUP OF MINNESOTA'S FUEL CONSUMPTION: FREE MARKET SCENARIO

SOURCE: Energy Division, Minnesota Department of Energy, Planning and Development, 1982

1. What do you notice about this graph? Jot down some things: _____

_____

_____

2. How is energy measured on this graph? _____

3. What is the title of the graph? _____

4. In your own words, write what the title means to you: _____

5. In the year 2000, what percent of Minnesota's energy demands can be provided by alternative energy sources? _____

6. Describe the demand for traditional fuels to the year 2000. _____

How does this differ from Student Sheet I? _____

From Student Sheet II? _____

7. Find the year you will be 30.

a. Is Minnesota using any conventional fuels? _____ How much less is that than now? _____

b. According to this graph can a significant proportion of demand be met by alternative energy supplies? _____

c. What do you think your life will be like? _____

Will it be possible for you to have everything you want? _____

If so, what might possibly prevent you from having what you want? _____

If not, what would stand in your way? _____

d. What is one possible effect of this energy future on people? _____

How will the effect you just described be different from the kind of energy future depicted by the graph on Student Sheet I? _____

_____

_____

On Student Sheet II? _____

_____

_____

8. Does this graph suggest that Minnesota can have energy self-sufficiency? _____

_____ What are the advantages of energy self-sufficiency?

_____

_____

Are there any disadvantages? _____ If yes, what are some of them?

_____

_____

9. Contrast this graph with the graphs on STUDENT SHEET I and II. Look at the year you will be 30. Which graph suggests a transition from now to then which is gradual, more-or-less planned and fair? _____

What are some reasons for your choice? _____

_____

Which graph suggests a more painful transition? _____

_____

What are some reasons for your choice? _____

_____

Which of the three futures do you most prefer? _____

Why? _____

_____

MINNESOTA ENERGY DATA: STUDENT SHEET III (continued)

What possible actions should you take to make that future happen? _____

_____

_____

What possible actions should our lawmakers take? _____

_____

10. Which of the three graphs suggests the biggest shift in our economy? _____

_____ Explain your answer. _____

_____

_____

11. In the past, we have relied heavily on coal, petroleum/natural gas. What are some characteristics of this kind of society?* _____

_____

_____

If/When we come to rely heavily on energy conservation and energy alternatives (e.g., solar, wind, biomass) how do you think the characteristics you listed above will change? _____

_____

12. Complete these statements.

a. If what is suggested in this graph happens, then _____

_____

* Think about this question for a minute. Do you have a tendency to name only "bad" ("good") things? If you have concentrated on "bad" ("good") things you should also add some "good" ("bad") things.

Does the question imply that we are a society doomed by the data on the graph? What is the reason for your answer? The purpose of the question is to ask you to think about ways energy influences our lives, choices and options.

b. If what is suggested in the graph on STUDENT SHEET I happens, then _____

_____

_____

c. If what is suggested in the graph on STUDENT SHEET II happens, then _____

_____

_____

Bits and Pieces of a Minnesota Energy Story

OVER VIEW When we learn and think about energy, it is also important that we consider our energy values. When we do this we are more likely to think seriously about the implications of the ways we use energy as well as ways we would like to see it used in the future.

ACTIVITY SUMMARY

Students react to 20 energy statements about Minnesota. The statements have been chosen from a vast array of possibilities. The students choose one of these responses to the statements: SO WHAT!, INTERESTING, or SOMETHING TO THINK ABOUT.

AS A RESULT OF DOING THIS WORK WE HOPE STUDENTS WILL:

* have a knowledge of some of the influences values have on relationships between people
* describe and explain their own feelings about beliefs
* identify beliefs and values of others in a dilemma situation
* encourage others to express their opinions and demonstrate an understanding of those viewpoints.

MATERIALS

For each Student
1 Student Sheet

For Class
Summary Chart
Overhead/Chalkboard

TEACHERS NOTES

1. Make a transparency of the summary chart or write it on the chalkboard.

2. Hand out the student sheet (or read each statement) and have students respond to the statements by raising their hand to one of the following responses: "SO WHAT," if students find the statement uninteresting; "INTERESTING," if students find the statement interesting or curious; or "SOMETHING TO THINK ABOUT," if students think it is a problem or an issue.

3. You/a student record the responses on the SUMMARY CHART. Save this chart.

4. If possible, have each student also collect responses to the statements from a parent/guardian. Students should record these responses on another summary chart so that they are available for comparison.

WORDS AFTER

1. Which item has the most even distribution of responses? What does this mean?

2. Which item is regarded by the class as least interesting (SO WHAT), most interesting (INTERESTING), as the biggest problem (SOMETHING TO THINK ABOUT)? What are some reasons?

3. What does looking at the numbers here (pointing) tell you?

4. What is the biggest surprise among the findings? Why? (Ask another student whether s/he agrees and why.)

5. What conclusions can you make from the data?

6. Would you say you have sufficient data to draw conclusions? What kinds of conclusions?

7. How could you be more certain about conclusions you made from the data?

8. What have you learned about Minnesota's energy story?

9. How do you think your parents/guardians would respond to these statements? Have students do this, record the data and look for similarities and differences between the student and parent/guardian data.

   * What conclusions can you reach from the two sets of data?
   * Are the conclusions you draw now better than the conclusions you reach using the student data alone? Why or Why not?
   * Is any evidence missing? What is it? How would you collect it? Can you get it all? Do you have to get it all to draw reasonably good conclusions?

ENERGY: SO WHAT, INTERESTING, SOMETHING TO THINK ABOUT

1. Traditional fuels used by Minnesotans include natural gas, oil, coal, propane and electricity.

2. At current rates of production total recoverable U.S. crude oil resources will be depleted in less than 40 years.

3. Electricity is a form of energy, not an energy resource.

4. There is an enormous untapped potential for energy conservation in Minnesota.

5. In one survey, 55% of the homes were found to have less than six inches of attic insulation; 12% had none.

6. One of the reasons for the lack of acceptance of some energy conservation measures is that the initial dollar requirements are large.

7. Passive solar heat is an energy resource which can be readily utilized with exisiting technologies and is economically attractive for many people.

8. The peatlands of Minnesota are among the last and largest undeveloped wilderness areas of the United States. The extent to which mining peatlands for energy use would affect the way nature works is not clear.

9. While the average household income in Minnesota has increased approximately 114 percent since 1970, gasoline prices rose 216 percent and natural gas prices rose 194 percent. As a result, an increasingly large portion of Minnesotans' incomes is going to energy payments, even after efforts to reduce energy consumption through conservation.

10. Improvements in the efficiency of energy use in Minnesota can provide more energy at a lower cost and more quickly than any other energy source available within the next 20 years.

11. Residential use accounts for nearly 15% of all energy consumed in Minnesota.

12. By 2000, Minnesotans could be paying nearly 45% more for petroleum products than they do today.

13. Alternative energy sources -- solar wind, hydroelectric power, energy crops (cattails, willows, grasses), animal wastes, urban solid wastes -- can provide 30% of Minnesota's energy use by 2000.

14. Money spent on conservation or locally produced alternative energy sources benefits the state more than money spent on traditional fuels because the money stays in the state.

15. The number of low-income households in Minnesota is between ten and twenty percent of the state's total population. Poor families spent an estimated 23 percent of their incomes on energy in 1981, while upper income families spent as little as 6 percent of their incomes on energy.

16. Because Minnesota has no oil resources, all petroleum must be imported.

17. Coal use is becoming increasingly important in meeting Minnesota's energy needs; however, great attention must be paid to its effects on the environment.

18. Minnesota has proportionately more coal or nuclear electrical generating capacity than the U.S. as a whole and is less dependent on either oil or natural gas for electric generation.

19. Minnesota has no known conventional sources of energy within its borders.

20. Minnesota's renewable resource potential is very large, but currently only a tiny fraction of our state's needs is met by these sources.

BITS AND PIECES OF A MINNESOTA ENERGY STORY: SUMMARY CHART

ENERGY

Items	So What!	Interesting	Something to Think About
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			

Some Minnesota Energy Alternatives: Trade Offs

OVERVIEW Minnesota has no known conventional sources of energy within its borders, though some have speculated that uranium may exist in commercially developable quantities. Peat is the only near-term unconventional, nonrenewable source of energy in the state. Minnesota's renewable resource potential is very large, but currently only a tiny fraction of our state's needs is met by these sources.

Nearly all of the energy resources used in Minnesota are nonrenewable. The basic features of these nonrenewable fuels can be grouped into three major categories: (1) a clean-burning, gaseous source of heat (natural gas and propane); (2) a highly concentrated, portable liquid that can be used in transportation systems or in remote areas for heat, electrical generation, or mechanical power (gasoline and fuel oils); and (3) a high-quality energy form that is easy to use for a wide variety of purposes (electricity). Solid fuels burned for thermal end-use purposes (coal) could be considered a fourth category, but currently they meet a very small percentage of thermal needs.

It is possible to burn new energy resources directly or convert them to a gas, liquid, or electrical energy form. The two essential ingredients of alternative sources of energy are the energy resource and an appropriate technology to convert it to desired substitute fuels (or systems that function as substitutes for the fuels) for a desired end use.

ACTIVITY SUMMARY

This is a set of short descriptive readings which provide students with an opportunity to: (1) collect and evaluate information on some of the problems and potentials of some of Minnesota's alternative energy resources; (2) become familiar with a variety of factors that must be considered and made sense of when energy decisions are made; and (3) begin to understand that answers to energy issues are seldom clear-cut.

AS A RESULT OF DOING THIS WORK WE HOPE STUDENTS WILL:

* learn to organize, analyze, synthesize and interpret information
* develop questions appropriate for obtaining information from source material
* describe the effects of unusual levels of pollutants on the environment
* describe ways human beings have modified their physical environment; explain some reasons for these changes; describe and evaluate the effects of such changes
* explain and evaluate ways in which natural resources have been/are/may be utilized in Minnesota.

* record observations and information from sources
* identify central elements in information
* learn to classify information
* examine their beliefs and values and the relationship between these and behavior

MATERIALS

For each Student
1 Student Sheet

For Class
1 Summary Chart
Overhead Projector/Chalkboard
1 Set of Readings, "Minnesota Energy Alternatives"

TEACHER NOTES

1. Make a transparency of the Summary Chart.

2. Run-off a set of readings for class.

3. Before your class does this activity have students write a statement describing what they think are some major characteristics of Minnesota's renewable energy resources.

   Ask some of the students to read their statements. Be sure students save them.

4. Divide class into an appropriate number of small groups. Then distribute to each group one of the sections from "Minnesota Energy Alternatives" or give the student groups a chance to select the energy alternative on which they would like to work.

   Each of the sections describes an energy source -- solar, petroleum, district heating, natural gas, hydro, wind, conservation, coal, biomass, (agriculture, wood, special energy crops, peat, municipal solid waste), propane and nuclear. The energy sources are <u>not</u> described in detail nor are the data presented in the same way. If you have books, clippings and articles about energy in your classroom you may want to use them for special and more detailed pieces of information as well as to supplement the readings. The library -- school or public -- is another resource that may be of value.

   Have students answer the questions in the chart as follows: Y = yes; N = no; and M = more information or study necessary. While these are all fuzzy categories the last one may be the most difficult. Students may wonder whether the information they have available is as complete as it might be. When each group finishes the assignment have them place their choices on the master chart.

5. Summarize and discuss the data. See **WORDS AFTER**.

WORDS AFTER

1. By examining the data in this table what do you know?

2. Why do you believe it? (Response to answer #1)

3. What, exactly, is the evidence you are basing your belief on? (Response to answer #2)

4. Where did the evidence come from? How good is the evidence? (Response to answer #3)

5. What does the evidence summarized in the table mean? What are <u>all</u> the possible interpretations?

6. Which environmental problems associated with these energy resources are really serious? Compared to what? Ask students to rank order the alternatives by a show of hands (1 = worst offender, 11 = least worst offender; Biomass is one category).

   Another way of ranking these would be on the basis of those renewables which have particular promise for reducing environmental costs, per unit of energy delivered where, 1 = most attractive environmentally, and 2 = least attractive environmentally.

7. Energy conservation can be thought of as an energy supply. What are some reasons for this?

8. Increased attention has been given in the past decade to the construction and use of energy systems that incorporate environmental and social consequences as well as the economic consequences. What are some reasons we are more willing to consider these factors?

9. When it comes to the interpretation of the term "environment" especially as it relates to energy considerations, do you prefer a narrow one limited to plants, animals and the physical landscape or a broad one encompassing humans and biogeophysical ones? What is your reason?

10. Refer the students to the statements they wrote at the beginning of this activity. Have them rewrite these statements to include what, on the basis of their study, they believe are the major characteristics of Minnesota's renewable/nonrenewable energy resources?

    How have the statements changed?

11. You have reviewed a menu of energy possibilities for Minnesota's future. Some criteria relevant to selecting future energy-supplies from this menu include: environmental, social, technological, and economic. At one time we based our selection of energy alternatives on technological issues only. How do you explain the interest in these other issues?

12. Do we seem to know more about the energy-related damages to the environment and public health from water pollution or air pollution? What is your evidence? Why do you believe it?

"DEFINITIONS" FOR STUDENT SHEET

1. **MINNESOTA RESOURCE:** Is the energy resource found in quantities large enough for development in Minnesota?

2. **RENEWABLE:** Energy sources derived from the sun or sources which renew themselves in generally less than 50 years. Included are direct solar energy, biomass, wind, hydro, some timber, urban residues, etc.

3. **ENVIRONMENTAL CONSEQUENCES:** Will the energy source in its production and use have acceptable environmental impacts on air, water, land, plants, animals?

4. **CONCENTRATED:** Energy resources differ in their quality which is a way of thinking about their concentration. Some forms of energy, like sunlight, are very dilute; others, like gasoline, fuel uranium and high-voltage electricity are very concentrated. Some energy resources can be gathered and concentrated.

5. **SOCIAL CONSEQUENCES:** Will the use of this energy resource influence the health and safety of people? The way we live?

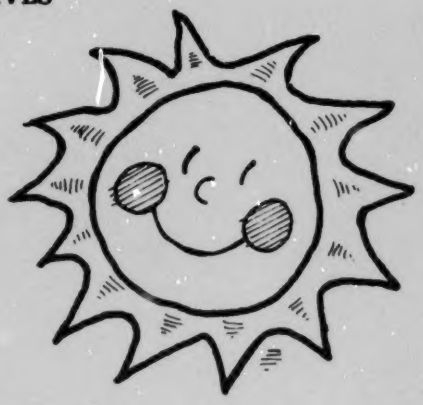
6. **AVAILABILITY:** Does this energy source have the potential to provide significant amounts of energy to meet demands over the next 20 years?

7. **ECONOMICS: PUBLIC/PRIVATE:** Is the development and use of this energy resource affordable?

8. **ATTITUDES (NIMBY - NOT IN MY BACK YARD!):** Is this energy resource compatible with people's values and attitudes about energy production?

MINNESOTA ENERGY ALTERNATIVES

SOLAR



Solar energy is the direct and diffuse radiation from the sun. It can be collected and used to provide heat and other useful energy. The most common type of solar collector is the flat plate collector. It consists of a black colored absorber plate, insulated on the back and having a glass or plastic cover that allows solar radiation to enter, but blocks heat from re-radiating out. The heat collected is transferred by air or water and is usually used for space heating or water heating. Several collectors are usually used in a solar energy system and heat is stored in water tanks or large rock bins for sunless periods. Solar energy can also be utilized in: passive solar houses where the building itself is the solar collector and storage system; concentrating collectors that use mirrors or lenses to focus the sun on an absorber; photovolta where sunlight is directly converted to electricity; and solar chemical fuel conversion, where solar energy is used to directly produce solid, liquid or gaseous fuels.

As solar energy becomes more developed, the right to sunlight will become more of an issue. Solar access is not now a legally protected right. As more collectors are used, government must help develop rights not to have sunlight blocked.

The direct solar resource can be applied to nearly all water, space, and low-temperature industrial-process heat requirements in Minnesota. Since there are no energy economic costs for resource production and the environmental constraints are minimal, development of this resource will grow in importance as new conversion technologies enable even greater use than is now economically feasible. Minnesota can expect a major increase in direct solar applications in the near future.

MINNESOTA PETROLEUM PROFILE

Annual Consumption	116 million barrels in 1978 529 trillion Btu/year (1978)*

*1 Btu = the heat given off by burning 1 wooden kitchen match
1 million Btu's = 8 gallons of gasoline
1 trillion Btu's = the heat required for approximately 10,000 homes for one year

PETROLEUM (continued)

Major Uses	Transportation	64%
	Residential	11%
	Industrial (including agriculture)	16%
	Commercial	6%
	Electricity	5%
Sources	All petroleum is imported Domestic Foreign	
Problems	Price rises Production cutbacks Potential supply disruptions and shortages Lower levels of economic activity Some oil development and transportation projects may cause serious environmental effects: air and water polution; transportation contributes to acid rain -- the tail pipes of cars and trucks contribute about 1/2 of the N_{ox} emissions. S_{ox} (Sox or sulfur oxides) + N_{ox} (N_{ox} or nitrogen oxides) + water = acid rain.	

Since Minnesota has no oil resources all petroleum must be imported. Petroleum enters the state primarily through crude oil and product pipelines. Lesser amounts of crude oil and residual oils also come in by barge. Small amounts of gasoline and fuel oils are transported by truck. In 1979, crude oil processed by Minnesota refineries accounted for about 56 percent of the petroleum products consumed; about 44 percent entered the state through product pipelines; and a very small amount came by barge, truck, or rail.

Nearly 83 percent of the refining capacity for the Minnesota area is located near the Twin Cities; the remaining 17 percent at Superior, Wisconsin.

For the years 1982 through 2000, U.S. petroleum production is expected to decline and prices are expected to rise; high prices will cause demand to fall below present demand. The decline in national demand will no doubt be pronounced and should imply decreases in the nation's imports of crude oil.

In the long-term, OPEC is assumed to control the world oil price. This price will play an important role in determining not only domestic petroleum production but also U.S. imports of foreign oil. The higher world oil prices are, the more the U.S. will be able to develop new oil fields and to derive oil from tar sand, oil shale, and coal. Higher world oil prices will tend to increase domestic production and to decrease U.S. imports of oil. Oil exporting nations typically try to collect the amount of revenues needed to satisfy their national development plans. The higher the price, the fewer barrels they need to produce in order to receive the desired amount of revenues. The high bill that the U.S. pays for foreign oil is a severe drain on the U.S. economy, and higher world oil prices will likely induce the U.S. to take measures to restrict imports.

MINNESOTA NATUPAL GAS PROFILE

Annual Consumption	275 trillion Btu/year (1980)	
Major Uses	Industrial	33%
	Residential	44%
	Commercial	22%
	Electricity	0.1%
	Agricultural	0.1%
Sources	Domestic Foreign (Canada)	
Problems	Escalating prices	

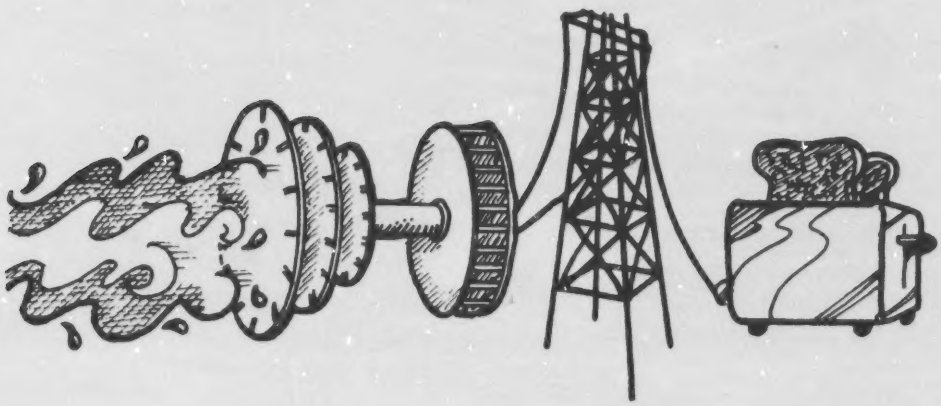
Natural gas is used by residential and commercial customers for such tasks as space heating, water heating, cooking and clothes drying. Natural gas burns cleanly, without giving off odors or particulate matter, which makes it especially well-suited to such uses. This characteristic is also valuable for certain industrial uses, such as the drying of milk, grain and other food products. Other industries, such as can and glass manufacturing, printing, and primary metals, use natural gas because it burns with a precise, steady flame.

An extensive pipeline system connects the gas well to the natural gas customer. Over one million miles of pipelines ranging in diameter from 1 to 42 inches exist in the U.S. for the transportation of natural gas.

Natural gas has historically been the least expensive of the conventional fuels. As traditional fields have been depleted, however, production costs have increased. Drilling costs for new wells have also risen.

A number of variables affect the amount of gas that will be available to Minnesota in the future. These include:

* The issue of how much natural gas lies underground remaining to be discovered is by no means settled, either for the United States or for the world. Some estimates of ultimately recoverable U.S. reserves are twice as high as other estimates.
* As the price of petroleum (the chief substitute for natural gas) rises, the incentive to produce natural gas also increases. World oil prices will continue to be dominated by OPEC's control of supplies, and will be subject to the economic and political conditions of each country.
* Rising costs of developing new sources of gas, including capital costs, will discourage new development.
* Federal decisions on the Alaska and Northern Border pipelines, approvals for importation of natural gas, issuance of offshore drilling permits, support for new gas technologies, and many other issues will have important impacts on the gas supply situation.
* Some gas development and transportation projects may cause serious environmental effects. For example, off-shore gas development may cause water-quality and aesthetic problems in coastal areas. Coal gasification to produce synthetic natural gas may have adverse effects on air quality, water quality and water use. These environmental costs may affect the development of new gas supply or transportation projects.



HYDROPOWER

Hydropower is energy derived from flowing water. The amount of energy available from any given stream is a question of the amount of water and the height which it falls. Ten gallons of water falling one foot has the same potential energy as one gallon of water falling ten feet.

Basically, hydropower facilities consist of a dam which backs up a reservoir and creates a difference in water height; a turbine run by the falling water and a generator to produce electricity.

Hydroelectric plants have been in use in Minnesota for 100 years, and since then most of the best sites have been developed. Even so, hydroelectric power now accounts for only about 2% of Minnesota's total electric capacity.

Minnesota has 31 dams currently producing power and 19 others that were shut down during the era of cheap energy. The largest potential for increasing the utilization of this resource is reactivating those dams shut down and increasing capacity at those dams already producing power.

Building a dam for hydropower is expensive and it produces significant environmental effects. This is important because many of the undeveloped sites with potential are on the scenic North Shore. It is probable that no new dams will be built for hydropower in Minnesota in the near future, although some existing dams currently used for navigation or flood control may be restructured to produce electricity.

WIND

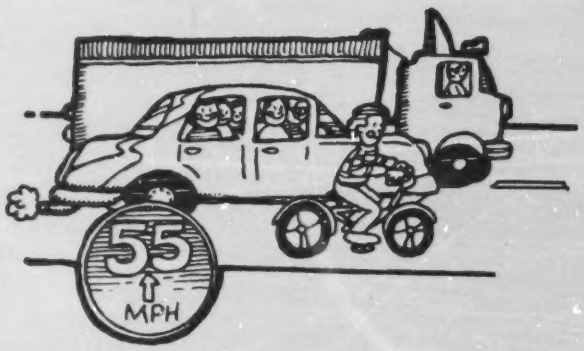
Wind is the motion of air masses that occurs when different areas of the earth's atmosphere are heated differently by the sun. Wind energy has been used since ancient times to propel ships, pump water and grind grain.

Modern wind energy systems usually are designed to produce electricity and consist of airfoil blades and a generator. The most important factor in siting a windmill is the wind speed. The energy content of wind increases dramatically with increased wind speed: a wind speed of 20 mph has eight times the energy of a wind speed of 10 mph. It appears that the plains areas in Western and Southern Minnesota and the North Shore of Lake Superior are good sites for wind- mills. Elsewhere in the state specific sites that are not obstructed by hills, trees or buildings also have potential.

While more specific data on wind speeds across the state is needed, it appears that wind-generated electricity can be competitive with average residential conventional electric prices.

With its widespread availability, wind energy represents a significant energy resource for Minnesota.

With no energy or economic costs for resource production and minimal environmental constraints, development of the wind resource is an important part of Minnesota's renewable energy future. Minnesota should place a major emphasis on wind energy.



CONSERVATION

Improvements in the efficiency of energy use in Minnesota can provide more energy at a lower cost and more quickly than any other energy source available within the next 20 years. The technology for harnessing this energy already exists and can be directly applied by individuals, businesses, and state and local governments. Almost 20 percent reduction in projected energy consumption can be achieved by the year 2000 through straight forward conservation measures. The cost of these measures would be less than the price paid by energy users for the cheapest of the traditional fuels. Although significant gains have been made in Minnesota, our conservation potential nonetheless is still largely untapped.

Conservation measures typically are substantially less expensive than the production of any new source of energy supply. Energy conservation promotes, rather than retards, economic growth and employment. Conservation not only decreases the drain of Minnesota dollars to energy suppliers outside the state but can create jobs, such as installation work. Furthermore, conservation can stimulate economic activity because less of Minnesota's income is spent to import energy and more is spent for Minnesota workers and products.

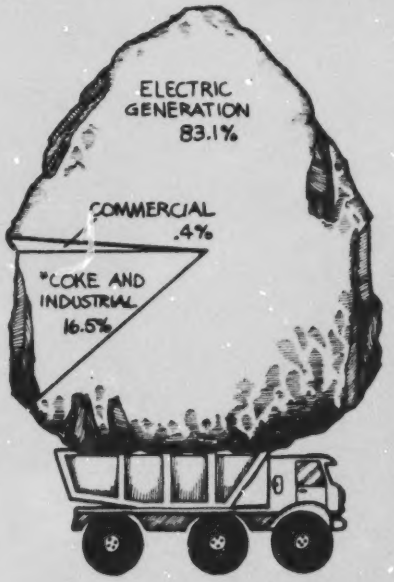
The idea of conserving energy has been clouded by false beliefs and preconceived ideas. Among them are the ideas that conservation means sacrifice and discomfort, and that it inevitably means a slowing of economic growth. Conservation is still regarded by many as being too hot in the summer and too cold in the winter.

Conservation reduces our demand for traditional fuels which have many serious environmental problems associated with them. It also buys time for the development of more environmentally acceptable energy technologies.

Conservation minimizes the impact of energy use on the environment. Energy conservation is not completely without environmental costs. Thorough weatherization of buildings can result in indoor air quality problems. (There is a device -- an air-to-air heat exchanger -- that lets you both ventilate a tight house and save the heat.) Firms installing or manufacturing insulation and other conservation materials generate some pollution.

MINNESOTA COAL PROFILE

Annual Consumption	13,203,000 tons (1978) (1 pound of coal = 9,400 Btu)	
Major Uses	Electricity	83%
	Industrial	16%
	Commercial	0.4%
Sources	Domestic 86% - west (Montana, Wyoming, North Dakota)	
	14% - east	
Problems	Increasing costs of the resource, transportation and taxes	



Coal became the nation's dominant energy resource during the last half of the 19th century. By 1900, it was meeting 90 percent of the nation's energy demands. The growing energy needs of the early 20th century, however, were met increasingly by cleaner, cheaper and more convenient fuels, namely, petroleum and natural gas.

Now, because of supply shortages and increasing prices for petroleum and natural gas, Minnesota and the nation are turning back to coal to provide an increasing share of their energy needs. Coal consumption in Minnesota increased 38 percent between 1970 and 1978.

No coal mining is done in Minnesota; however, the use of coal in Minnesota contributes to serious environmental effects in other states -- including particulate emissions from exposed land, degradation of water quality, and disturbance of other land uses such as grazing. Socioeconomic effects also occur from the influx of people into small towns as mines are opened and operated. The resolution of environmental problems caused by increased mining of western coal will have a direct effect on coal supplies in the state.

Another mining issue involves the reclamation of strip-mined lands. The Surface Mining Control and Reclamation Act of 1977 imposes strict environmental requirements on western mines. Industry opposition to the requirements is vigorous, and the regulations are still being revised. It is possible that at least some of the major western suppliers will be required to alter their operations substantially. Requirements to reclaim land, combined with shortages of the equipment needed for land reclamation, could limit available coal supplies.

Construction of coal-fired generating plants leads to increased coal mining, which adversely affects the air and water quality of the states where it is mined. It also leads to increased railroad traffic. To supply a typical 800 MW facility with fuel, five unit trains (each train having about 100 cars and carrying about 10,000 tons of coal) are needed every week. Noise, traffic congestion and air pollution result.

Generating plants require land which must be removed from its current use. Hence, construction of power plants causes disruption of people's lives as well as of the terrain, vegetation and wildlife.

COAL (continued)

Water plays a vital role in the generation of electricity. Large quantities of water are used to dissipate the waste heat produced by generating plants. The use of water at generation facilities affects both water supply and water quality.

In addition to thermal pollution, water discharges from cooling towers contribute other pollutants to waterways. A portion of the water circulating in the cooling system is constantly discharged and replaced by fresh water. Continual evaporation from the system concentrates the natural constituents of water. Consequently, the discharged water contains four to ten times the natural concentration of dissolved solids in the intake water, as well as other pollutants.

Combustion of coal produces significant quantities of solid wastes, including ash and sludge from the operation of scrubbers. Disposal of these wastes requires considerable land, and there is potential for contamination of groundwater and surface water from improper disposal.

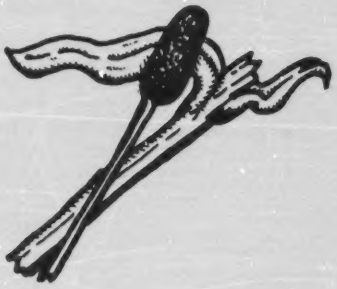
Combustion of coal produces sulfur dioxide, nitrogen oxides and particulates, all of which can have detrimental effects on human health, vegetation, livestock, wildlife and property. Combustion may also release some radioactive materials occurring naturally in coal. In addition, coal-burning plants emit certain trace elements for which there are no state or federal standards; currently, little is known about the possible effects of such emissions.

Burning large amounts of fossil fuels may also cause acid rain. Combustion of fossil fuels releases sulfur dioxide and nitrogen oxides into the atmosphere. These gases can be converted to sulfuric acid and nitric acid and return to the earth with precipitation. In 1976, 334,465 tons of sulfur dioxide were released into the atmosphere from sources in Minnesota; 72 percent of this came from coal consumption.

Acid rain may increase the acidity of lakes and affect aquatic life. Lakes in northern Minnesota lack alkaline soils to buffer acidity and are therefore more vulnerable to damage from acid rain. There is concern that acid rain may contaminate lakes in the Boundary Waters Canoe Area and the Voyageurs National Park on the Minnesota-Canadian border. Acid rain may also cause damage to crops, reduction in forest productivity, contamination of water supplies through metals released from soils and pipelines, and deterioration of man-made materials such as buildings, metal structures and paint. Transmission lines affect land use and are perceived as an aesthetic problem in many areas. Land use is affected by overhead transmission lines regardless of construction techniques.

Considerable concern has been expressed about the effects of transmission lines on agricultural production. The efficient use of farm equipment may be disrupted, especially where structures are not aligned with property lines of field boundaries. Transmission lines may also create noise and disrupt residential uses, forestry, recreation, communication, aviation and television and radio signals. The possibility of adverse health effects from transmission lines has been extensively debated.

BIOMASS



Biomass is plant matter, including all direct or indirect plant matter waste. It is chemically similar to fossil fuels and can be converted to a liquid or gaseous fuel; it can also be burned directly if sufficiently dry.

Biomass production is attractive in Minnesota because of the proximity of source to need and the relatively high availability of sunlight and water. In addition, fuels from biomass can be used to directly replace conventional fuels.

Biomass is a relatively inefficient converter of solar energy, partly because there is no plant growth in the winter. Thus large land areas must be used for biomass energy production. This will require more careful environmental assessment and control than other renewable energy sources. Some biomass materials are currently or potentially more valuable as food or raw material. These competitive uses will tend to focus development on non-competitive biomass sources such as special energy crops.

Special Energy Crops

Special energy crops are plants grown specifically for their energy content. They are characterized by high yields of plant matter per acre, their ability to thrive on land not suitable for agriculture or forestry and low energy inputs, for growth and processing. Many species are being investigated such as alder, aspen, cattails, grasses, reeds and willow. Cattails grown in the wetlands and peatlands of Northern Minnesota are of particular interest and are being researched at the University of Minnesota.

Because of Minnesota's large areas of undeveloped peatlands and wetlands, special energy crops have the greatest potential of any renewable biomass energy resource in the state. Nevertheless, the effects of development on water resources, wilderness areas, open space and wildlife habitat must be carefully considered.

Peat

Peat is dead, partially decayed plant material that has accumulated in a wet environment over several thousand years. While peat is chemically similar to biomass materials, it renews itself so slowly that for practical purposes it is considered a nonrenewable energy resource. It can be converted into solid, liquid, or gaseous fuel by the same process used for biomass.

Minnesota has large areas of peatlands, primarily in the Northern area of the state totaling 7.2 million acres. In developing peat for energy, attention must be paid to its effects on regional hydrology, wilderness areas, and wildlife habitat.

BIOMASS (continued)

Peat can be an important source of energy for Minnesota. Mining of peat for direct energy use should be coordinated with land reclamation through production of renewable biomass, such as special energy crops.

Agricultural

Agricultural crop residues such as corn stalks, corn cobs and wheat straw are primarily used as a soil conditioner by being plowed under after the crop is harvested. A certain proportion of crop residues could be removed and used for energy without reducing the soil fertility.

With proper cultivation techniques and the return of much of the nutrient content to the soil after the energy value has been extracted, 30 percent average removal should be manageable. Crop residues require little additional energy for gathering, beyond that used to grow the initial crop, and could provide a significant energy resource for Minnesota.

Wood

Wood and wood residues are derived from tree species grown on forestland. A significant number of Minnesotans burn wood for residential heating, especially in outstate areas, and many commercial and small industrial users also use wood fuel. These uses are likely to increase in the 1980's. However, most of the wood harvested in Minnesota is used for paper or lumber products, and it is expected that this use will increase and compete against the energy use of wood. While Minnesota's forests are currently underutilized, it is possible that within 15 years the forests will be nearly completely utilized for paper and lumber production. This would make using wood for fuel uneconomical, because the wood would be more valuable as paper and lumber than as fuel.

Municipal Solid Waste

Currently solid waste is being burned in several plants in Minnesota to generate steam. Solid waste, as collected, is about 2/3 combustible material, mainly paper.

Use of municipal solid waste for energy is more desirable than the current practice of disposal in landfills; however, even more energy benefit may be gained by recycling the resource, including the paper portion.

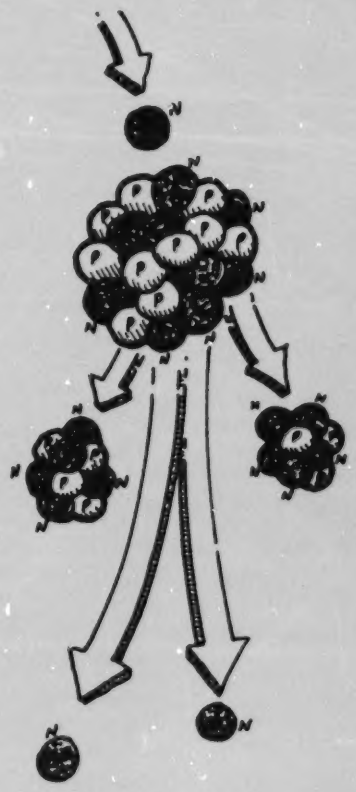
MINNESOTA NUCLEAR PROFILE

Annual Electrical Generation	1,539 Megawatts/year (1980)
Contribution to Electrical Energy Supply	31.8%

NUCLEAR (continued)

Contribution of Uranium to Total Primary Energy Supply	9.9%
Major Uses	Electricity
Sources	100% Domestic
Problems	Long-term storage of radioactive wastes

Of the electricity generated in Minnesota by electric utilities in 1980, 83.7 percent was generated using coal; 31.8 percent, using nuclear fuels; 2.5 percent, using oil and natural gas; and 2.0 percent, using hydro facilities. The higher percentages for coal and nuclear units reflect the fact that these units are used for baseload or intermediate capacity; most oil and gas units are used only for peaking. Because Minnesota has a greater proportion of coal or nuclear generating capacity than the U.S. as a whole, Minnesota is less dependent on either oil or natural gas for electric generation.



The 1979 accident at Three Mile Island and other accidents have led to increased concern about the safety of these plants. There are also strong concerns about long-term storage of radioactive wastes and mining and processing of uranium.

It is assumed that Minnesota's nuclear plants will be operated through the year 2000, not forced to shut down because of safety problems or lack of storage for spent fuel. A nuclear power plant must be carefully decommissioned at the end of its operating life because of the radioactivity accumulated in its structural components. The future costs of decommissioning nuclear plants at the end of their useful lives are presently subject to a wide range of estimates.

Nuclear power plants produce "low-level" and "high-level" radioactive wastes. The low-level wastes consist mainly of compactible materials (paper and rags, for example) and contaminated chemicals. This material is currently shipped to Washington and Nevada, but these disposal sites will either be unavailable in the future, or available only for limited amounts of wastes. Neighboring states are now negotiating agreements under which regional low-level radioactive waste will be stored at one site in the region. Waste from nuclear power plants would typically account for one-third of the wastes stored there.

NUCLEAR (continued)

The spent fuel rods of nuclear power plants produce all of the high-level radioactive waste generated in Minnesota, although nationally the largest share of high-level waste is produced by the military. On-site storage pools for spent fuel have been expanded recently at all three nuclear sites in the state. The state's nuclear plants should have sufficient on-site storage for all spent fuel produced until geological repositories for ultimate disposal become available in the mid-1990s. The ultimate cost of disposal in geological repositories cannot be accurately projected until more is known about the cost of disposal in specific geological formations and until the uncertainties associated with siting and licensing facilities are resolved.

PROPANE

Liquefied petroleum gas (LPG) is a term used to describe a group of hydrocarbon fuels including propane, butane, isobutane, and butane-propane mixes. Propane, C_3H_8, is the most widely used making up 98 percent of all LPG consumed in Minnesota. Propane is a product of natural gas processing and crude oil refining. It is also found at the wellhead in conjunction with natural gas and petroleum.

At normal atmospheric pressure and temperature propane is an odorless and colorless gas. An artificial odorant is usually added for easy recognition and safety. Only when the fuel is stored under pressure and at low temperature is it a liquid. Liquid propane occupies 1/270 the volume of the gas.

In rural Minnesota propane is a popular fuel for space and water heating, cooking, crop drying, and carburetion. Consumption has declined steadily from a high of over 412,000,000 gallons in 1973 to only 296,566,000 gallons in 1980.

The residential sector is the largest user of propane in Minnesota. In 1980 over 115,000,000 gallons were consumed for cooking, space heating, and water heating. This represents nearly 39 percent of all propane used in the state. Residential users include single and multifamily dwellings and mobile homes.

Principal users in the commercial sector include restaurants, banks, garages, hospitals and office buildings. In 1980 47,200,000 gallons were consumed in the commercial sector. This represents nearly 16 percent of the propane used in Minnesota.

Agriculture is the second largest user of propane. In 1980 over 85,000,000 gallons were used for crop drying, fueling tractors and other farm vehicles. This represents nearly 29 percent of the propane used in the state. Crop drying is the largest single use in this sector. Propane is popular for grain drying because of its portability and clean burning characteristics.

Industrial consumption of propane is classified as either back-up or primary. As a back-up use, propane is substituted in the natural gas system when natural gas supplies are interrupted or curtailed. In the past as much as 75 percent of the total amount used by industry has been as a back-up. The industrial sector uses nearly 14 percent of all propane used in Minnesota.

PROPANE (continued)

Since 1978 propane has become very popular as a motor fuel for fleet vehicles. This group includes public service vehicles (police, ambulance, etc.), utility maintenance vehicles, school buses and short haul delivery trucks. In 1980 the transportation sector consumed 8,300,000 gallons or nearly 3 percent of all propane used in Minnesota.

Domestic propane production meets approximately 52 percent of Minnesota's needs. Supplies come from natural gas processing plants and petroleum refineries in the south central U.S., and to a much smaller extent from local refineries in Minnesota. Minnesota also imports propane. In 1980, an estimated 48 percent of Minnesota's total supply came from Canada. It is transported via rail, truck, and the Cochin Pipeline.

Domestic production of LPG is expected to remain steady through the 1980's. By 1990 production is expected to increase to 255,000,000 barrels per year from the present 250,000,000 barrels per year. This increase will result as proven LPG reserves on Alaska's north slope are recovered.

Worldwide production of LPG is expected to increase significantly throughout the 1980's. Current forecasts suggest the world supply of LPG (propane and butane only) will jump from 605,000,000 barrels in 1980 to 960,000,000 barrels by 1985. Production will center in Canada, North Africa, the North Sea, and the Middle East.

Before the Arab Oil Embargo in 1973 and the tightening of world oil supplies, LPG was regarded as a by-product of natural gas and petroleum. These products were often flared or burned as a waste gas at the drilling site. Today LPG has developed more stable international markets including heating homes and industry in the U.S., fueling automobiles in Europe, and electric generation in Japan.

Logistics and the pipeline delivery system serving Minnesota will restrict much of Middle East, Africa, and North Sea imports from actually reaching Minnesota. But the indirect impact of these supplies will continue to make LPG and propane competitive with other sources of energy.

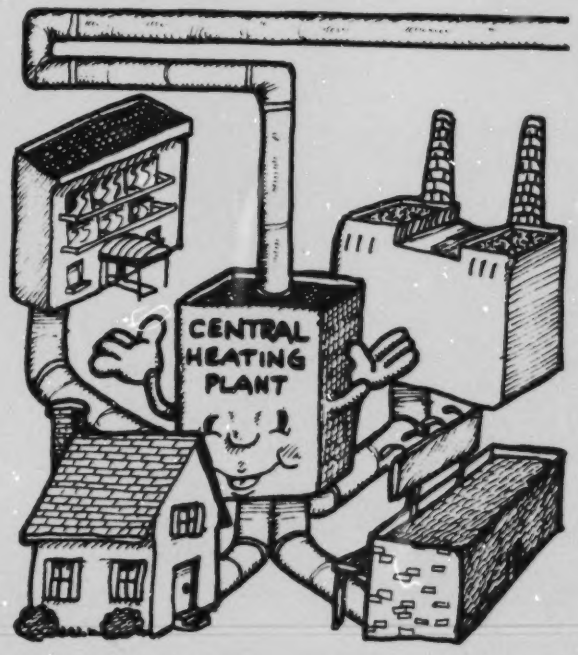
DISTRICT HEATING

District heating is the distribution of heat energy from a central source to commercial, industrial and residential customers for space and water heating or for certain industrial processes. A district heating system consists of three elements: 1) a central heat source such as a coal-fired electrical generating plant or a heat-producing boiler; 2) a heat load or thermal energy demand made up of end users or customers such as hospitals, businesses, colleges, apartment buildings, single family homes, and schools; and 3) a distribution network to move the heat energy from the heat source to the end users.

Two kinds of district heating systems are commonly used: steam and hot water. In general, steam is suitable for industrial use where higher temperatures are required or for district heating over relatively short distances. (This may be up to five miles.) In a steam system, heat is supplied to the buildings by the condensation of the steam. The condensate may be returned through a second pipe or disposed of through the sewers. Both types are used today.

HEATING (continued)

Hot water is suitable for relatively long-distance heating because pumping stations can be installed along the distribution network to move the hot water. These systems are similar to the hot water systems found in many homes. One pipe carries hot water from the heat source (furnace) to the individual buildings where it is used to heat radiators. It is then returned through a second pipe to the heat source to be reheated and reused.



If the central heat source is a power plant, the plant's efficiency may be increased even more by using cogeneration. Cogeneration is the use of reject heat which is produced while generating electricity. Electric generating plants use only about one-third of the energy of the coal they burn. Nearly two-thirds of the energy is lost as reject heat to the environment. Use of this reject heat that would otherwise be rejected to the environment will help provide lower and more stable heating costs.

District heating offers several other advantages for Minnesota communities. It encourages economic growth but reducing energy cost, building local self-reliance and attracting new business. It improves air quality since pollution control devices at the central heat source will reduce air pollution. Water quality is also improved since less heat is rejected to nearby waters. And district heating provides flexibility for the future since its fuel source can be peat, biomass, refuse, wood waste, or coal as well as traditional fuels.

District heating is not a new technology. At one time, Minnesota had as many as 30 steam district heating systems. However, when inexpensive oil and natural gas became available, several district heating systems found it impossible to compete. Currently, 14 steam district heating systems are in operation in the state. Many of these have been in continuous operation for over 50 years, but are worn out and in need of some changes.

We're moving into an era of high-cost energy and unstable fuel supply that promoted Northern Europeans to develop hot water district heating over 30 years ago. Today, three out of eight million people in Sweden live and work in buildings heated by water district heating. So although steam district heating has been used in the U.S. before, hot water heating which is more efficient and can be distributed to a larger area than steam, will be new for us.

Although there are no hot water systems in the United States today, several Minnesota communities such as St. Paul, Moorhead, Red Wing, and Willmar are doing extensive studies to see if this is a viable option for them.

SOME MINNESOTA ENERGY ALTERNATIVES. TRADE OFFS: STUDENT SHEET

	Petroleum	Natural Gas	Propane	District Heating	Coal	Nuclear	Conservation	Solar	Wind	Hydro	Biomass				
											Agriculture	Wood	Special Energy Crops	Peat	Municipal Solid Waste
MINNESOTA RESOURCE?															
RENEWABLE?															
ENVIRONMENTAL CONSEQUENCES?															
CONCENTRATED?															
SOCIAL CONSEQUENCES?															
AVAILABILITY?															
ECONOMICS: PUBLIC/ PRIVATE?															
ATTITUDES (NIMBY)?															

Energy and Low Income People

OVERVIEW Poor people were aware of the energy crisis long before the rest of Minnesota began feeling the pinch in home energy bills, at the gas pump, and elsewhere. In northern climates low-income people may spend 25 to 30 percent of their income for fuel and utilities. In comparison, middle-income people in the same climates would spend 7 to 10 percent of their income on fuel and utility bills.

ACTIVITY SUMMARY

Students become familiar with some of the energy costs of two households: low income and not low income. They then read and respond to two energy plans for low income people. The purpose of the activity is to stimulate fresh thinking about issues of responsibility -- personal, community, and institutions.

AS A RESULT OF DOING THIS WORK WE HOPE STUDENTS WILL:

* acquire knowledge about decision making
* identify some common concerns which people share
* identify some decisions about services in communities and states; suggest some reasons for these decisions and indicate possible effects of these decisions
* recognize societal barriers to full development that may exist
* express an interest in the physical, intellectual and social conditions of human beings
* suggest ways one can personally and practically help improve the conditions of human beings.

MATERIALS

For each Student
3 Student Sheets

TEACHER NOTES

1. Reproduce Student Sheets I, II and III.

2. Students will need some help getting started with Student Sheet I. Ask students: "Where can you find the information which will help you complete this chart?" Answers will include looks of puzzlement, and responses - "don't know," "libraries," "books," "Ms. Wilson will know, she teachers economics," "newspaper ads tell housing and car costs," "insurance agents," etc.

   Discuss with your students the possibilities of a parent/guardian helping them with the assignment. Emphasize that the activity is focusing on broad categories and relative percents or dollar amounts. You are not asking students to disclose family finances. A parent/guardian is in a good position to say "Have you looked at the price of groceries lately? That percent you have listed seems a little low to me!"

3. Discuss the questions on Student Sheet I.

4. Distribute and discuss Student Sheets II and III.

WORDS AFTER

1. What options are left to poor people as energy costs increase?

2. What are the elements of a poor person's energy plan?

3. What criteria would you use to judge the effectiveness of an energy plan to assist the poor? Should such a program maximize energy savings or hold energy costs to within 10-15 percent of a low income household's total budget or must a permanent solution be developed to the "inability-to-pay" problem?

RESOURCES

"Energy and the Poor: An Imperative for Action." 1979. The National Center for Appropriate Technology, P.O. Box 3838, 3040 Continental Drive, Butte, MT 59701.

ENERGY AND LOW INCOME PEOPLE: STUDENT SHEET I

SITUATION I

You are married and have two teenagers - boy 16 and girl 14. You have a total annual family income of $28,000.00.

Determine your major categories of expenditures your family will have during the year and the amount (% or $) budgeted for those expenditures. Some examples of major household expenditures include: food, medical, taxes, electricity, heating, housing costs, clothing, car purchase and/or payments, entertainment/recreation, insurance, education costs, etc.

Category	Amount % or $

SITUATION II

You are married and have two teenagers - boy 16 and girl 14. You have a total family income of $9,360.00.

Determine your major categories of expenditures your family will have during the year and the amount (% or $) budgeted for those expenditures. Some examples of major household expenditures include: food, medical, taxes, electricity, heating, housing costs, clothing, car purchase and/or payments, entertainment/recreation, insurance, education costs, etc.

Category	Amount % or $

ENERGY AND LOW INCOME PEOPLE: STUDENT SHEET I (continued)

Category	Amount % or $

Answer These Questions:

1. Are the two lists the same length? Why or why not?

2. What percent of their income do poor people spend on energy? What percent of their income does the other family spend on energy?

3. The following data were calculated by the Energy Division, Minnesota Department of Energy, Planning and Development, 1982. The calculations are based on normal heating degree days and the energy forecasts include rates of change of inflation rate from 1982 - 1995. (The Data Resource, Inc., U.S. Long-Term Review, Summer, 1981.)

ENERGY PRICE PROJECTIONS:
AVERAGE ANNUAL COSTS FOR MINNESOTA

Year	Fuel Oil	Liquid Petroleum Gas	Natural Gas	Electricity
1978	$ 1,002	$ 1,068	$ 664	$ 1,019
1982	1,606	1,449	1,069	1,734
1987	2,304	2,278	1,865	2,263
1992	3,267	3,277	2,667	2,976

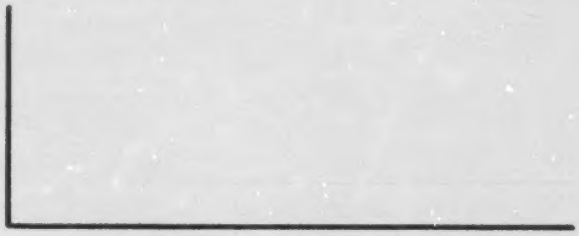
* Which energy source doubles in cost first? Last?

* Assuming other costs stay fixed, what percent of income will low income families be paying for energy in 1987? 1992? The other family?

* For each energy source, in which year does the cost change the most?

* As consumer's spendable income changes, what are some other likely economic effects?
* Why do prices keep rising?
* Suppose you are that low income family the year you graduate from high school. Assume other expenses increase. What would you give up first? Last?
* What are the necessities of life?
* If each family (poor and non poor) spends the same amount of money on energy in 1987, do they spend the same percentage?
* Complete the following two bar graphs:

Percent of increase spent on energy



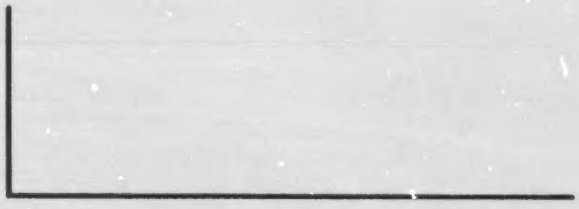
low income family | non-low income family

The reason I completed the graph this way is because _____

_____

_____

Household energy use



low income family | non-low income family

The reason I completed the graph this way is because _____

_____

_____

ENERGY AND LOW INCOME PEOPLE: STUDENT SHEET II

On December 14, 1981, Northern States Power Company announced a plan to give poor Minnesotans in its service area a 25 percent discount on electric rates. In NSP's area some 105,000 households would directly get a break. The idea has also been advanced in Northern Minnesota Power Company.

The difference would be paid by charging slightly extra to other residential, commercial and industrial electric customers. What this means for those who qualify for the program is about a $7 a month savings and it would cost the typical residential customer about $4.50 a year more. The total annual cost for the program is about $8 million.

I think this is a good/bad (circle one) idea because _____

_____

_____

_____

As you might guess, the proposed NSP plan of providing direct financial aid to low-income electric customers, resulted in many questions and comments. In February 1982, Don McCarthy, Chairman and Chief Executive Officer of NSP, provided additional explanation and rationale for the proposal. The full text is reproduced below.

To Our Readers:

Northern States Power Company (NSP) proposed in December a 25 percent rate break for low-income Minnesota electric customers. The proposal brought a flood of questions from NSP customers, as I expected. Their concerns seem to center on the company's role as a provider of electricity--an essential of daily life--and whether we should get into the social engineering business: that is, help find a way to aid low-income people in paying their energy bills.

Fundamentally, NSP believes that cost-based rates are the best public policy; that is, rates under which each customer class (residential, commercial and industrial) pays the full cost of service. In general, NSP will continue to seek rates that accurately allocate cost by customer class.

However, that fundamental policy assumes government has solved the inability-to-pay issue, using a method independent of utility rate structures. Unfortunately, this is not the case.

Further, NSP recognizes that as all living costs--including the prices of electricity and gas--rise, an increasing number of residential customers will require aid. But the President called on the private sector in October to help fill the gap left by federal cuts in social programs. And Minnesota's serious budget difficulties do not make the state a likely place to look for help.

Given these circumstances, NSP believes it has an obligation to work with government in order to assure every residential customer a reliable, continuous supply of essential electricity.

Our proposed 25 percent rate break would provide meaningful assistance to those who need it, with small impact on our other customers. With about $8 million of assistance, NSP customers within 125 percent of the federal poverty income guidelines could better come to grips with their energy costs. Costs to the rest of our customers would increase only 1-1/4 percent. (This adds up to about 38 cents a month for the typical residential customer using 550 kilowatt-hours.) We would consider this program part of the cost of doing business, similar to costs for fuel to generate electricity or for uncollected bills.

NSP is not saying the Minnesota Public Utilities Commission (PUC) should adopt this specific proposal; modifications might well be desirable or necessary. What we are doing is pointing to a problem, offering one possible way to alleviate that problem and requesting that the appropriate public agencies and community groups work with us toward a solution.

At the same time, we're not abandoning conservation. That's a step we all must take to make the most of valuable and finite energy sources and to keep rising energy prices in line. The program we propose for our low-income customers is designed to provide essential daily requirements.

We've heard a great deal the last few years about the dangers of bigness, about solving our problems at home, about the need to stop looking to Washington as an endless source of solutions to our problems.

What is our responsibility? And how can the private sector help in alleviating some of the more pressing problems of poverty?

Energy is NSP's business, so we are looking in the energy area for answers to that question. We are presenting our proposal to the PUC in February. We hope our supporters and critics alike come forward to help us find the answer.

(SOURCE: ENERGY UP DATE, Opinion Section,
February 1982)

Answer These Questions:

1. You are a shareholder in NSP. The NSP plan assigns the cost of the program to its ratepayers; not with financial assistance from the utility itself. The Minnesota Public Interest Group proposed that NSP shareholders should pay for 25 percent of the program.

   MPIRG argues that this would improve ratepayer acceptance of the program. NSP argues that stockholders demand an adequate rate of return on their investment and that electric rates would have to be increased to compensate for any loss in revenue.

   Where do you stand on this point? Why?

2. Some refer to the NSP proposal as a kind of energy tax. Do you agree or disagree? Why?

3. What economic and social responsibilities do electric utilities (or energy suppliers) have to low-income consumers? Should we expect the same kind of plan of used-car dealers? Of telephone companies? Of stores? What values are you using in making your decision?

4. One argument against the NSP plan is that it might discourage energy conservation in the homes of low-income families. (Before you answer, consider this question: Is weatherization a way to reduce electrical costs?) What is your response to that argument?

5. Don McCarthy, the Chief Executive Officer of NSP, said in defense of the plan that "It is clear that today a basic amount of electricity is vital to existence just as food or water is." Do you agree or disagree? Why?

6. The Energy Division of the Minnesota Department of Energy, Planning and Development, opposes the NSP aid plan. The Energy Division argues that any proposal to solve the "inability-to-pay" problem must be a permanent solution and NSP's is not. (An example of a permanent solution: Let the utility's low-income customers get a 25 percent discount on their bills until their homes are weatherproofed under a program NSP would run.)

   Suppose, for the sake of argument, that in the long run the best policy is investment in conservation. How do you then deal with the immediate affordability problem for low-income consumers of electricity?

7. Suppose, after housing weatherization, low-income households still needed help with their electric bills. How would you solve this problem equitably and economically?

8. What change, if any, would you make in the NSP proposal? If your answer is no change, what is your reason? If you propose a change, provide justification for your answer.

9. In Minnesota, approximately two-thirds of all residential energy consumption is for space heating, with another 17 percent going for water heating. Only about 7 percent of all Minnesota homes are electrically heated. The proposal is/is not (choose one) too narrow because _____

   _____

   _____

   _____

10. The NSP aid plan would/would not (choose one) improve the economic well-being of low-income persons. Give a reason for your choice.

11. Does the NSP proposal represent a long-term solution to the "inability-to-pay" problem? Why or why not?

In 1979, the National Center for Appropriate Technology (NCAT) proposed a major federal initiative, which they believed would both attack the devastating energy problems of low-income people and begin to demonstrate the promise of renewable energy. Elements of the NCAT energy policy proposal are reproduced below. Transportation and food are deleted.

Low-Income Energy Assistance

The first element of the NCAT poor people's energy policy is an expanded crisis intervention, low-income energy assistance program. This program, which will require large expenditures for a few years, should be viewed only as a stop-gap measure. It should be phased out as conservation and solar technologies are implemented to pick up the energy load for low-income people. This assistance program will save or supply no new energy. But it must initially be a critical part of the NCAT energy program because it meets an absolute and very well defined need. Without emergency assistance for cold-climate areas, low-income people who cannot pay their fuel bills will quite literally freeze. But this interim program should be phased out because there are other technologies which can eventually reduce poor people's energy bills to affordable levels by saving heat or supplying natural energy. We must remember that a dollar spent for low-income emergency energy assistance pays for a certain quantity of fuel which is burned and temporarily keeps a poor person warm. It is used once; it cannot be recovered or used again. A dollar spent for conservation or solar energy, conversely, continues to supply new energy day after day and year after year. Thus, any rational long-term energy program must incorporate these elements.

The cost of this phase of the program was estimated at $3 billion/year initially; time for completion was estimated as 5 years (maximum).

Home Energy Conservation

The next program in the NCAT energy policy is massive and extensive weatherization of low-income housing. Weatherization is a bureaucratic name for energy conservation technologies used to improve the thermal efficiency of a residence. "Weatherization" includes ceiling, wall and water-heater insulation; storm windows and doors; caulking and weatherstripping; window repair and general leak plugging; and furnace maintenance and repair. It is important to remember that energy consumption in the residential sector accounts for nearly 20 percent of all U.S. energy consumption, a proportion that could be substantially reduced through weatherization. Thus, weatherizing the 16 million low-income residences is a major energy target.

The cost of this phase of the program was estimated as $24 billion overall; time for completion was estimated as 5 years.

Solarization

The next element in the NCAT enery policy is a "solarization" program, a logical follow-up to weatherization. Weatherization can reduce residential heating load to the point where solar energy can be a cost-effective space-heat source. Solar energy, often criticized as a plaything of the rich, instead is ideally suited for low-income people. Although the initial capital costs of solar energy are often substantial, the operating fuel costs can approach zero. If government programs subsidize the intial cost, solar energy systems can go a long way toward reducing low-income energy bills to manageable proportions.

Like the initial stages of the weatherization program, the national solarization program must be targeted. First, as a general rule, solar space-heating systems should only be installed in homes that already have been weatherized so their conventional energy consumption is cut to a minimum. Next, the specific site of each house where a solar energy system is to be installed must be considered, since only about a third of existing residences are suitable.

The issue of eligibility is also important for solarization. Solarization, along with weatherization, should be available to renters as well as homeowners. Fifty-five percent of low-income households are renters rather than homeowners. The energy problems of these people are just as important as those of homeowners. If the overall government purpose is to provide a subsidy to supply energy as cheaply as possible for all Americans, the energy supplied (saved) through conservation or solar applied to a rented dwelling is just as useful as energy from an owner-occupied building.

The cost of this phase of the program was estimated as $10 billion overall; time for completion was estimated as 5 years.

from "Energy and the Poor: An Imperative for Action." A Policy Proposed by the National Center for Appropriate Technology, 1979.

Answer These Questions:

1. What do you like and dislike about this proposal?

2. How is it similar to the NSP proposal? How is it different?

3. How are we to reach the goals the NCAT proposal suggests? To reach these goals what are some of the trade-offs we would have to make? What values are you using in making your decision?

4. Do you agree with the authors of the report that a transition to renewable energy is necessary if low-income people are to break away from continually increasing energy costs? Why or why not?

5. How do you think this proposal could be improved?

6. Tell why you agree or disagree with the following statement: The right way to provide assistance to the poor is by such measures as weatherizing homes to permanently reduce a family's energy bills to an affordable level. Such approaches have a multitude of advantages: the family will face the true cost of the fuel used thereby encouraging appropriate consumption; the state's tax burden will be reduced because conservation is cheaper than the fuel it is replacing; and the economy will be stimulated by using a local industry.

Minnesota's Energy Future: The Delphi

OVER VIEW Developed by the RAND Corporation (a think tank) in the 1960's, a technique called Delphi has been used throughout the world by corporations and governments for forecasting assistance, developing suggestions for new product opportunities, and as a decision-making tool.

The Delphi is essentially a questionnaire technique. It was designed to improve the use of expert opinion through a series of polls based on three conditions: anonymity (the experts did not know their fellow panelists), statistical display (results are summarized), and feedback of reasoning (the summary is returned to panel members). When futurists use it, each question asks when (what year) the respondent (usually an "expert") thinks a particular event will take place and if s/he thinks it will take place at all. The Delphi technique is based on the assumption that a panel of experts can reach an accurate consensus on the time range within which a given event will occur in the future.

A Delphi is conducted in a series of rounds. In the second and third rounds, the respondents have summarized data available to them as well as comments on items explaining the reason for a choice. In these rounds, respondents can alter their predictions or provide counterarguments. After the second or the third (and sometimes fourth) polling, answers tend to converge. The first round is used to expand awareness of alternatives; the following rounds are used to develop arguments and provide data to other respondents; the last round provides opportunity for respondents to evaluate the justifications given by those who have not placed their answers in the consensus area. Futurists then use the results to develop a set of alternative futures based on the data and the probable date of occurrence of the event.

The stress on achieving "consensus" in a Delphi is often abused. The Delphi provides a futurist with a picture of the degree of uncertainty and the range of opinion on a variety of events. Delphi's are not always the work of experts although they are often presented that way. The technique can mesmerize people into believing that collections of such opinions are valid technological predictions. Even experts may have little or no expertise on some of the precise technological or economic or social issues raised. The Delphi, therefore, should be used with caution. Because there are no right answers, the Delphi is a valuable tool; it provides people an opportunity to think more deeply about the future and to share their perspectives with others.

ACTIVITY SUMMARY

Students use a modified form of the Delphi technique. The exercise is designed for a group effort, in a compressed period of time. Questionnaires are distributed in class, the first poll results are summarized and then the questionnaire and the data are returned to the class. The second and third round are used to discuss and clarify reasons for the answers.

AS A RESULT OF DOING THIS WORK WE HOPE STUDENTS WILL:

* be able to distinguish statements of fact from statements of opinion
* be able to identify stated and unstated assumptions
* be willing to modify positions in the light of new factors or considerations
* acquire a futures approach in problem solving.

MATERIALS

For each Student
1 Student Sheet

TEACHER NOTES

1. To obtain a number of future energy possibilities for Minnesota, you must collect some statements on energy. There are several ways to do this.

   a. Brainstorm a list of energy possibilities. The rules are:

      1) List anything that comes to mind. (Don't be afraid to encourage wild ideas, humor.)

      2) No discussion.

      3) No evaluation. ("Hey, that is a good idea" or "Wow, that is a weird idea" are not allowed.)

      4) Expect repetition of ideas.

      Ask members of the group to suggest future energy events, e.g.: most power comes from solar energy; all fossil fuels are completely used or 75% of all used automobile oil is recycled.

      Use a chalkboard or butcher paper or an overhead projector to record the events suggested. When the group is finished ask members to review the list and to eliminate those that mean the same thing. Reduce the list to about 15-25 items. If the lists are longer students will probably find the Delphi questionnaire task wearisome and boring. To be useful, many of the brainstormed ideas will have to be turned into statements, e.g., the phrase "housing conservation code" might read: "Communities will have a uniform housing conservation code"; the phrase "electric cars" might read: "Electric automobiles will be in common use"; the phrase "alternative energy sources" might read: "Conservation and alternative energy replace large amounts of traditional fuels."

b. Ask each person in the class to list energy events that s/he expects to take place in the future. Select 15-25 items from these lists.

c. Use the attached list of events.

2. Distribute the Questionnaire and do Round 1. Ask each student to assign occurrence dates. If participants think that an event will never occur, have them write "never." Encourage students to provide arguments and reasons for their prediction dates after each item.

3. Have a group compile and tally the responses to the events. For each item have students circle the year in which the number of tallies lying above it are roughly equal to the number of values lying below it. This is the median (50%). Students should also compute the mean.

4. Provide these results to the class and do Round 2. Ask students to reconsider their responses to the original questionnaire. This time they will have some class opinion on the issues. Students may or may not choose to change their answers. Ask students who are at the end points of the continuum their reasons for their answers, but encourage students not to conform to majority opinion for the sake of conformity.

5. Discuss and summarize the experience. See **WORDS AFTER** .

WORDS AFTER

1. When we create a new energy technology, do we try to find out how our future may be affected by that technology? Give some examples.

   Suppose we did try to find out how the future would be affected by a particular technology. How would you go about deciding whether or not a particular energy technology might in fact be a problem? Do you think it would make matters better or worse? Why?

2. If your parents were asked these questions would they have answered the same way? (How would their responses be different? Similar?)

3. What do you think of Minnesota as a place to live? What predictions do you make for it twenty years from now? 50 years? 100 years? What bad/good things do you expect the future to bring?

4. What effect do you think modern energy technologies have had on Minnesota? On its people?

5. True or False. The world that we will experience in five to twenty years is being shaped by decisions made now. Why?

6. What are the characteristics of a desirable energy future for Minnesota?

7. What could be done in Minnesota to make a desirable energy future become a reality?

8. Do you think Minnesotans will be able to solve the problems we're having with energy? Can you give any examples that lead you to believe that?

9. How do you sort out opinions about energy problems/solutions we might have in the future?

10. Which Minnesota energy problems can be dealt with? What can be done about them? How might they be solved? If (student answer) didn't work, what then?

MINNESOTA'S ENERGY FUTURE: THE DELPHI: STUDENT SHEET: ENERGY FORECASTS

Instructions: Below are listed some energy events that could occur and have an impact on the quality of life in Minnesota. Place an "x" on the column representing the time interval during which, in your opinion, the event is likely to occur. If you believe the event is highly improbable place an "x" in the never column. Indicate with an "x" whether you think the event is desirable/undesirable, probable/improbable, good/bad. There is some space for you to write what you think some results of this event might be and some space for you to write some reasons for your answers.

DEVELOPMENT

	1982-1985	1985-1990	1990-1995	1995-2000	Never	Desirable	Not Desirable	Probable	Improbable	Good	Bad	Some Results of this Event Will Be	Reasons
1. Dams will once again become important producers of electricity.													
2. Superinsulated homes -- houses well-built for cold climates--will be constructed in a big way.													
3. Hot water district heating programs will heat downtown areas in several Minnesota communities.													

MINNESOTA'S ENERGY FUTURE: THE DELPHI: STUDENT SHEET: ENERGY FORECASTS (continued)

DEVELOPMENT

	1982-1985	1985-1990	1990-1995	1995-2000	Never	Desirable	Not Desirable	Probable	Improbable	Good	Bad	Some Results of this Event Will Be	Reasons
4. Utilities will take direct responsibility for providing conservation services for their customers, e.g., weatherization.													
5. For more than half a century, utility companies have enjoyed a monopoly on the generation and sale of electricity. Small companies and homeowners, e.g., of wind generators, will give them a profit or reduce their electric bill by selling their surplus power to the utilities. (An energy bill passed by Congress in 1978 requires utilities to buy power from small power producers.)													
6. Systems for converting farm animal wastes and residues for farm energy (biogas) will be widely used.													

DEVELOPMENT

	1982-1985	1985-1990	1990-1995	1995-2000	Never Desirable	Not Desirable	Probable	Improbable	Good	Bad	Some Results of this Event Will Be	Reasons
7. There will be on-farm fuel alcohol plants which can use corn and other agricultural products.												
8. Crop-drying systems will be fueled by crop residues.												
9. A program that will beneficially and permanently help low income and fixed income energy users deal with rising energy prices -- prices which rise such that they become an unbearable portion of household incomes -- will be developed. (The inability-to-pay problem will be solved.)												
10. Cattails will be extensively developed as a special energy crop.												
11. The energy potential of urban waste products will be understood and urban wastes will be used for energy production.												

MINNESOTA'S ENERGY FUTURE: THE DELPHI: STUDENT SHEET: ENERGY FORECASTS (continued)

DEVELOPMENT

	1982-1985	1985-1990	1990-1995	1995-2000	Never	Desirable	Not Desirable	Probable	Improbable	Good	Bad	Some Results of this Event Will Be	Reasons
12. Timber will be used for energy -- including the use of wood residues.													
13. Minnesota peatlands will be used for energy in an eventually acceptable manner.													
14. There will be adequate long-term supplies of petroleum products in Minnesota.													
15. There will be an improved capability to forecast electricity needs.													
16. Minnesota will have an aggressive policy to promote energy conservation and alternative energy sources.													

DEVELOPMENT

	1982-1985	1985-1990	1990-1995	1995-2000	Never	Desirable	Not Desirable	Probable	Improbable	Good	Bad	Some Results of this Event Will Be	Reasons
17. Every community will have a local official who is an "energy detective." Her/his job will be to track down energy use and costs in all city operations and to identify energy conservation possiblities.													
18. A majority of Minnesota homes will reach optimal levels of conservation.													
19. Vehicle registration fees will be charged on a miles-per-gallon basis.													
20. We will decrease our dependence on traditional energy supplies.													
21. There will be a statewide solar access permit system for "sun rights."													

MINNESOTA'S ENERGY FUTURE: THE DELPHI: STUDENT SHEET: ENERGY FORECASTS (continued)

DEVELOPMENT

	1982-1985	1985-1990	1990-1995	1995-2000	Never	Desirable	Not Desirable	Probable	Improbable	Good	Bad	Some Results of this Event Will Be	Reasons
22. Solar will provide a significant contribution to energy savings.													
23. Heating water now accounts for about 15 percent of household energy use. More than 25% of all houses will have solar hot water heating systems.													
24. Total household energy use will decrease by 25% (due to more efficient appliances and energy conservation).													
25. There will be statewide building standards for energy efficiency.													
26. Electric vehicles will be common for limited-range urban driving.													

Minnesota's Energy Future: The Scenario

OVERVIEW A scenario is a narrative that describes an alternative future by developing the history leading up to it. The writer begins by describing the future state of "x," for example, the economic and social impacts of rising energy prices. S/he then tries to construct a probable history of the evolution of the current state to that future state.

Professional futurists often construct a whole series of scenarios in which they try to exhaust all likely futures for "x," taking into consideration all the factors in the present that they possibly can. From this array of future states, they choose the one that they regard as well-reasoned and most probable.

Scenarios help us to think about the future and reflect on the present. They are not predictions of the future but rather alternative possibilities in which the imagination has played with some of the alternatives. Scenarios are expecially useful in this process because they can help us organize our ideas. Scenarios also help us to more clearly distinguish between probable futures and desirable futures.

ACTIVITY SUMMARY

Students write a description of a possible energy future which explores the sequence of events leading to a future state.

AS A RESULT OF DOING THIS WORK WE HOPE STUDENTS WILL:

* acquire a futures approach in problem solving
* use a writing style appropriate to purpose and audience
* know that writing can be used to stretch the imagination concerning ideas about the present and future
* appreciate writing as an important means for improving learning and thinking
* know how to organize observations, ideas and feelings about energy futures
* distinguish between desirable energy futures and probable energy futures
* think about what must be done to make a desirable energy future emerge.

TEACHER NOTES

1. Have students develop and organize a sequence of events, each shaped by the ones preceding it, which will lead to a Minnesota future based less on traditional fuels and more on a conservation/alternative energy resources future. Students will probably find the graphs from "MINNESOTA ENERGY DATA" useful in organizing their thoughts.

   You will set the limits on the organization and length of the paper. Ask at least two students to volunteer to read their compositions to the rest of the class.

2. Use the **WORDS / AFTER** to debrief the activity.

WORDS AFTER

1. Help students make some distinctions between desirable futures and probable futures.

   Ask students to discuss the graphs from the Minnesota energy activity titled MINNESOTA ENERGY DATA in terms of their desirabiltiy and probability.

   What is the difference between desirable and probable? Who stands to benefit most from these futures? Who stands to gain the least? What are some social consequences of these alternative futures? After you and the students generate a list, have students evaluate them, good/bad. Which of the alternative energy futures will be most marked by social conflict, e.g., in the relations among energy companies, public utilities, labor unions, environmental and consumer organizations? What makes you say that?

   Ask students: "If you lived in the future portrayed by Graph __, what kinds of things would you be able to do? Not be able to do?"

2. What must be done to make a desirable future emerge? A probable future?

3. What are ways to take an action to help make a desirable future happen?

4. How much control do we have over our energy futures? What do you think are the worst problems facing Minnesota's energy future? How did these problems occur? Which ones can be dealt with? How might they be solved?

The Energy War Between the States

OVERVIEW In July 1981, a study released by the Northeast-Midwest Congressional Coalition indicated that Minnesota and Wisconsin pay more than twice as much per household for energy -- heating, air conditioning, cooking and lighting -- as some Western and Southern States.

In 1980, the study found, Wisconsin's household energy costs averaged $1,264, sixth highest in the nation, and Minnesota's household costs averaged $1,112, the 16th highest. New Hampshire and Maine led the nation with household energy costs averaging $1,450 each. In contrast, household energy costs averaged just $501 in Washington, $503 in California, $569 in Hawaii and $620 in Oregon.

One obvious explanation for the higher costs in the frost belt states is that they consume more energy for home heating. But differences in consumption do not always account for the wide variations in energy costs. For example, the study shows, the average household consumption is no higher in New Hampshire, the state with the highest energy costs, than it is in Washington, the state with the lowest costs. One reason energy costs are so high in New England States is that they depend heavily upon fuel oil for residential heating. Energy costs in Washington tend to be held down by its heavy reliance on hydropower for electricity.

ACTIVITY SUMMARY

Students read and react to information about the coal severance tax and its impact on Minnesota.

AS A RESULT OF DOING THIS WORK WE HOPE STUDENTS WILL:

* identify some of the factors determining income distribution
* have a knowledge of some of the effects of government policies on consumers
* become familiar with the regulatory, allocative, distributional and stabilization role of government in our economy
* know some of the general energy and economic characteristics of regions
* know some ways in which natural resources are allocated
* identify and explain some of the political and economic interactions between states.

TEACHER NOTES

1. Make copies of the student sheets.

2. Distribute Student Sheet I. Clarify meanings of words and any ambiguous terminology.

3. Ask some of your students to read their responses. Note and comment on some of the recurring themes. After a student reads a response, try to extend the discussion and produce fruitful arguments. Ask questions such as:

   "Jackie, do you agree with John?"
   "What is the evidence?"
   "If that is so, then why...?"
   "I don't understand what you mean. Please tell me again."
   "How would you design an experiment to test that idea?"
   "How could you be more certain about...?"

4. Make copies of Student Sheet II. Distribute one set of voice clouds (statement and response) to each student. Be sure that several students get the same clouds. Ask students to respond. Then have them read their statements and responses aloud. You might want to post the statements and responses.

5. Distribute Student Sheet III - "The Last Word." Ask students some of the following questions about the article.

   * What does the article say?
   * What does it mean?
   * What is the writer's main point?
   * Do you agree with it? What is your reason?
   * Is the writer's main point the central issue?
   * In what ways, if any, does the article suggest reasons why the issue of severance taxes is a difficult one?
   * How is this article similar to other evidence you know about the severance tax? How is it different?
   * Is the article biased? What evidence are you using?
   * Is the article an accurate account of the severance tax issue?
   * Are there any statements of error? What are they?
   * Is this a statement of fact or opinion?

6. Distribute Student Sheet IV. Instructions for debriefing this activity are on the sheet.

WORDS AFTER

1. What does "fair" mean (at least as it relates to energy)? What criteria might be developed to determine fairness? Brainstorm a list with your class.

2. Many Montanans point-out that states with irreplaceable minerals, such as West Virginia, simply have not prepared for a future without these resources. Montana's coal is a finite resource. Coal mining creates dramatic impacts and after it's gone, so is the economy which depended upon it. Montanans argue they are trying to invest in and protect their future.

Have the class apply the fairness criteria which they developed to the fairness of the severance tax. How does one decide what level of tax is fair? Is 0% fair? 5%? 10%? 20%? 30%?

3. What qualities should a fair and equitable state energy policy possess?

4. What qualities should a fair and equitable national energy policy possess?

5. What are the similarities and differences between a fair state and a fair national energy policy.

6. Some people have said that the energy rich states are "exporting" a major part of their tax burden on their citizens to consumers in other states. Do you agree? Why or why not? Is it "fair"?

7. In the editorial, in Student Sheet IV, it was noted that the U.S. Supreme Court upheld a decision -- 6 to 3 -- to allow Montana to continue the "export tax." In that decision the Court left the way open for Congress to set limits. Is it a basic right of states to collect severance taxes to meet the needs of state and local government or should the federal government limit the amount of severance taxes states can place on oil, natural gas and coal? What are some reasons for your choices?

READ AND REACT

Montana contains about one-fourth of all known U.S. coal reserves and more than half the nation's low-sulfur coal reserves. About 90 percent of Montana's coal is shipped to out-of-state buyers.

In July 1981, the United States Supreme Court ruled that Montana can impose a 30 percent tax on the production of coal. The tax, known as a severance tax, is a form of excise tax on the mining or extraction of natural resources. Minnesota charges a severance tax of about 4 percent on extracted iron ore.

In 1975, the Montana State Legislature passed a law which dramatically increased the rate at which coal is taxed. Coal was taxed at 34 cents per ton in 1975; in 1980 coal was being taxed at $2.08 per ton. The tax yielded about $60 million for Montana in 1979. This severance tax is imposed on all coal, regardless of whether it's sold inside or outside the state. In defense of Montana's severance tax one spokesman said: "We learned a big lesson from our own history. Anaconda Copper took billions of dollars of copper out of Montana and left nothing behind. So our governor demanded that we get the revenue so that when the coal is gone, something will be left behind in Montana."

In 1979, the Montana severance tax and a similar 17% levy on coal in Wyoming cost Minnesota consumers about $24 million. The taxes are passed along by the utilities to the consumer in the form of higher electric bills. NSP, for example, depends on Montana for about 90 percent of the coal they use to generate electricity. The severance tax cost NSP customers more than $12 million in 1980 -- $4.22 for an average residential customer. Minnesota Power Company puts the cost at about $4.50 for its typical residential customer.

O.K. Is the severance tax fair?

I think it is because _____

_____

_____

_____

I think it isn't because _____

_____

_____

_____

If I were from Montana I would think it is/isn't (circle one) because _____

_____

_____

_____

_____

The prime justification for a severance tax is to preserve something for future generations, not so much trying to rip-off the consumer. We're going to have to live with what's left behind. Manufacturing industries don't deplete resources, it adds to the worth of the state. With mining they just pull up stakes.

New Mexico Secretary
Of Energy and Minerals

You

"Western states have shown great willingness to allow strip mining to help supply energy to the rest of America. But we are determined that we not be made a national sacrifice in order to heat Minneapolis or air-condition Detroit."

North Dakota
Representative
to Congress

You

Montanans are willing to share their vast coal reserves with the rest of the nation; all we ask is a fair return for the full cost of extracting that resource from our land.

Governor
Of Montana

You

There is no justification for allowing Montana and other Western states to exploit the luck of their boundary lines and reap unearned, windfall taxes on an energy resource that belongs to all of us.

Minnesota Representative to U.S. Congress

You (as a Montana resident)

Severance taxes on energy resources are going to create a group of superstates with a lot of power over their less fortunate cousins.

You

If you look at history you don't have to look far to see this state has been ripped off. They took our copper, gold, silver, gas. We have been like a colony for the rest of this country.

b
Montana Governor

Does Montana need such a high tax rate?

a
Newspaper Reporter

You

Look at Tennessee, Kentucky, West Virginia -- states that didn't prepare for the future. Do you want your children to inherit that? We've got to protect ourselves.

Governor of Colorado

You

Western states are a domestic version of OPEC.

Minnesotan

You

Fifteen years ago Colstrip was a town of 300 people. Today it has 4,000 people. We use the money from severance taxes to pay for schools, streets, water and sewage systems. Why should people who live there have to spend the next 20 years paying for impacts they had no control over?

State tax Official, Montana

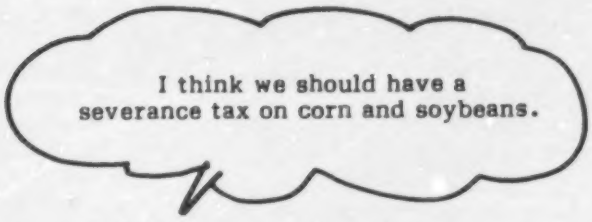
You

New York State doesn't have any oil but it has gas companies and gas stations and distribution centers. I heard that New York State is attempting a big tax on oil company operations within its borders. I think Minnesota should do the same.

Minnesotan

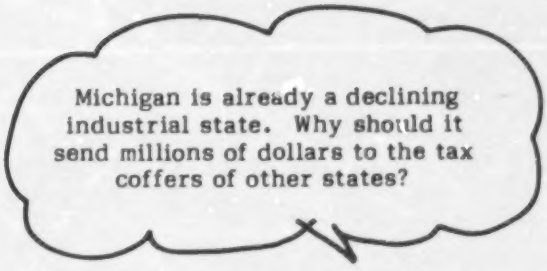
You

Minnesotan



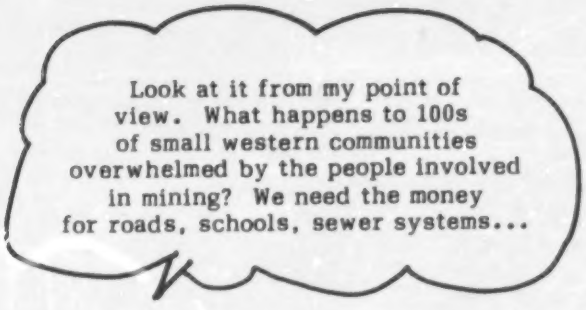
Minnesotan

You
(as a Montana resident)


Michigan is already a declining industrial state. Why should it send millions of dollars to the tax coffers of other states?

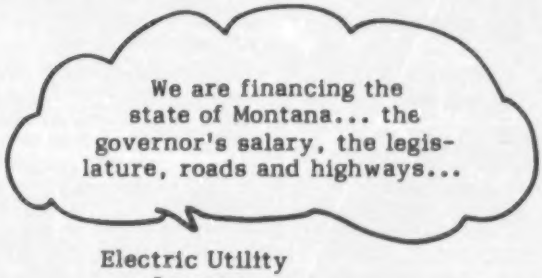
Person from
Michigan

You


Look at it from my point of view. What happens to 100s of small western communities overwhelmed by the people involved in mining? We need the money for roads, schools, sewer systems...

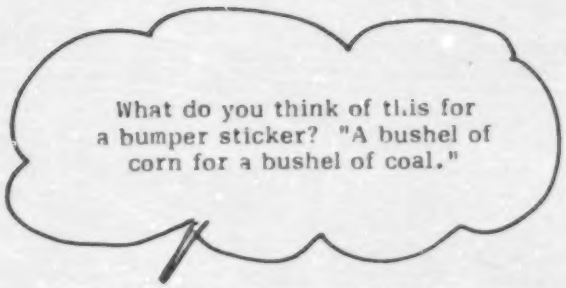
A
Montanan

You



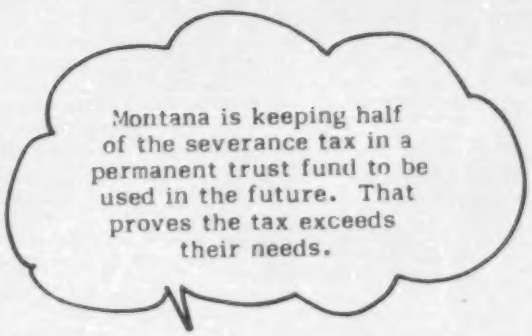
Electric Utility
Lawyer

You



Minnesota Farmer

You


Montana is keeping half of the severance tax in a permanent trust fund to be used in the future. That proves the tax exceeds their needs.

Minnesotan

You

THE LAST WORD

Sen. David Durenberger, R-Minn. is a generous man. Durenberger wants to share the wealth - Montana's wealth.

Durenberger seems to believe that when God created Heaven and Earth in six days, the Deity must have taken Thursday afternoon off.

You see, the Almighty put all that coal under Montana and Wyoming, all that oil under Texas, Alaska and Louisiana, and left Minnesota with nothing but wood to burn iron.

The Senator has a plan to correct the Lord's oversight. Durenberger has drafted legislation that would cut back Montana's coal severance tax by $40 million annually, replace the Montana tax with a federal excise tax to be used to subsidize the purchase of fossil fuels by energy-poor states overlooked on that Celestial Thursday.

There would be something for everyone in Durenberger's bill. Montana would be relieved of $40 million and Minnesota would be able to buy cheaper coal.

Durenberger calls his plan "equity."

The Durenberger proposal has upset Montana's congressional delegation. For some reason, our men in Washington do not like the way the Minnesotan would cut our pie.

But, perhaps they are not being fair. The plan is a good one, it simply does not go far enough.

If we are going to share the nation's energy wealth, let us share everything else. Montana's a fine state, after all, but it is not perfect. The Big Sky does lack a few of the amenities that grace other states.

For example:

Let Minnesota buy cheap coal. Montana needs a port. Duluth would do nicely.

We wouldn't want to force Durenberger's home state to give up any of its 10,000 lakes -- to do so would cause Minnesota the enormous expense of recalling all its license plates. But if the Land of Lakes could spare about 10 inches of rain a year, we could use the moisture.

We have always believed that it was a waste of energy to have 100-car unit trains carrying coal to Minnesota and rolling home empty. The trains should swing past Otter Tail County to be filled with that fine black prairie loam. We will spread it over our Rosebud County. Then there will be coal under Minnesota soil. That should please the Honorable David D.

Montana would also welcome a division or two of the industrial giant, 3M. Anaconda and Butte are waiting with an ample supply of workers and a fine union tradition.

We, too, are a generous people. Cheap coal would not be sufficient payment for these boons. We would insist upon giving more.

If at least half the Viking, North Stars and Twins home games were played in Montana, we would offer Minnesota:

* More than 3,000 miles of bad roads.
* Crippling freight rates to distant markets.
* A shortage of investment capital.
* Saline seep, stripmining, and the Berkeley pit.

As a show of good faith, I would ask Sen. Durenberger to begin by sending us the Guthrie Theater. By return mail, we will sent him a batch of wild ducks enriched with endrin.

Roger Clawson
Billings Gazette

Coal is clearly a common interest that ties Minnesota and several states together. The United States is not a patchwork of states in which consumer states and supplier states are at war with one another. We have a sense in this nation that burdens and benefits are to be shared on a more or less equal basis. Read the following excerpt and answer the questions below it.

> This country faces the threat of an economic civil war, setting energy-rich "have" states against energy-poor "have-not" states.
>
> The weapons are rip-off severance taxes, analogous to export taxes.
>
> For example, Illinois residents pay Wyoming enough to cover the entire cost of Wyoming's Legislature, plus the pay of the governnor, his cabinet, the highway patrol and the revenue department, which collects the 17.5 percent "export tax" on Wyoming coal.
>
> The Minneosta Energy Agency* sees devastating dangers in the increasingly large transfer payments from Minnesota to the "have" states, in the form of a slack economy and unemployment induced by a lack of capital for investment. What is occurring is essentially a massive shift in competitive relationships among the states.
>
> To be sure, Minnesota historically has had a modest iron ore severance tax, but that is distributed throughout the U.S. economy rather than burdening particular regions for the benefit of Minnesota. Are the new severance taxes so high that they will produce a hemorrhage of capital from the have-not regions?
>
> At the root of fears that the U.S. will become a Balkanized patchwork of selfish regions is a fundamental constitutional issue. The Founding Fathers saw the stupidity of regional trade barriers and therefore created what became a great continental free market. They deliberately gave Congress alone the power to regulate interstate commerce. And while the Supreme Court has throughout our history knocked down such barriers, it upheld, in a 6-to-3 decision, the Montana "export tax." Nevertheless, the court openly invited Congress "to thwart efforts such as those of Montana."
>
> Clearly, there has to be a national policy. One approach would be to scale down what will be left of federal program dollars to "have" state governments living high on the hog from energy export taxes.
>
> Austin Wehrwein
> Minneapolis Star
> September 3, 1981

What is the conflict?
Who is in conflict?
What is the issue in this conflict?
What values are in conflict?

---

*This is now known as the: ENERGY DIVISION, MINNESOTA DEPARTMENT OF ENERGY, PLANNING AND DEVELOPMENT.

You are to write a position statement on this issue. It is to start with one of the following phrases: "My position..." "From my point of view..." "The way I see it..." You are to include your thoughts about the problem, the facts as you know them, and the relationships between the facts as you see them. Do not write your name on your paper.

When you have finished, your teacher will collect and mix the papers up. You will be given a paper from the pile. Read the statement to the class and listen while others read from the papers they drew.

The Most Benefit for the Least Cost

OVERVIEW Energy conservation is cheaper than new energy production. An analysis and comparison of the costs of energy conservation and energy production should be the basis for making economic decisions about energy. Energy conservation appeals to some people on the basis of broader issues, such as consistency with personal philosophy or concern with future generations, but these hard-to-quantify factors are not likely to influence vast numbers of decisionmakers in homes and businesses. Most individual and business decisions are based primarily on direct economic costs. The capital and operating costs of conservation and energy production projects, the interest rate on money, and the return on alternative investments are likely to be key factors in energy conservation decisions.

ACTIVITY SUMMARY

Students become familiar with the comparative costs of conservation and the costs of energy from other sources. Students also examine the opportunity cost concept, one of the more important tools of analysis in economics.

AS A RESULT OF DOING THIS WORK WE HOPE STUDENTS WILL:

* Know how to make energy-economic decisions
* apply criteria in making economic decisions which include such economic goals as freedom, efficiency, and equity
* identify the opportunity costs involved in personal and societal economic decisions
* recognize economic incentives and their effect on individual consumers.

MATERIALS

For each Student
2 Student Sheets

TEACHER NOTES

1. Reproduce Student Sheets I and II.

2. Distribute Student Sheet I and clarify/discuss the assignment. When students are finished, discuss the questions with the class.

3. Before you distribute Student Sheet II you will want to discuss the idea of opportunity costs with students. A brief summary of the concept is found below. You will probably want to amplify these brief ideas and provide additional examples.

   One of the fundamental concepts of economics is opportunity cost or alternative cost (they are used synonymously). Where choices are made, one course of action is accepted while another is denied or rejected. The rejected course is the "cost" of the accepted choice. The alternative/opportunity cost is the value of the opportunity that is sacrificed. The use of the economic concept of alternative/opportunity cost is to compare benefits -- those anticipated and those given up.

   The concept of opportunity cost is not limited to things that can be measured in dollars and cents. For example, if a student must choose between studying for an exam and playing basketball at the park, s/he experiences costs and benefits no matter what choice is made. If s/he decides to study, certain benefits are received and these must be weighed against the opportunity for fun given up by staying home. Such decisions are difficult to make because a wrong decision is always possible -- the costs may exceed the benefits.

   The popular version of alternative/opportunity cost is found in the term "trade-off." In a study of energy and the environment, this notion has real appeal.

4. Have students do the opportunity cost worksheet - Student Sheet II.

5. Discuss the answers to the worksheet with the students.

WORDS AFTER

1. What are some reasons people disagree over the use of economic resources? Energy resources? The environment?

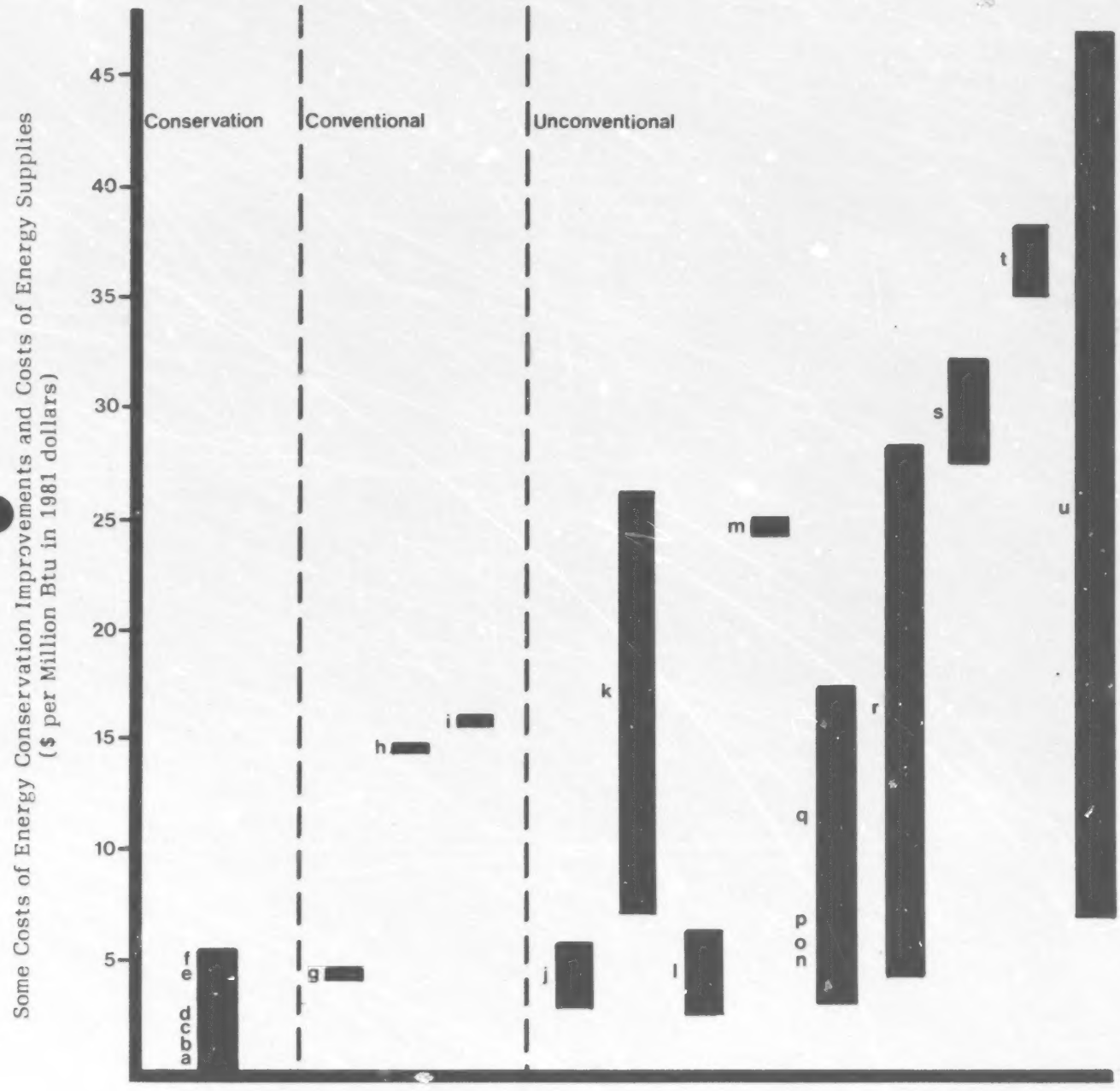
2. In what ways can state government influence energy use in Minnesota? Which of these do you like best? Least? Why?

3. Should conservation measures which cost more than producing new energy supplies be discouraged? Encouraged? Why or why not?

4. Should the development of new energy supplies which cost more than energy conservation measures be discouraged? Encouraged? Why or why not?

5. We are constantly making choices on how to spend our limited resources to get the most benefit for the least cost. If costs included all costs such as capital, labor and pollution concerns, our search for the best bargain should result in our energy resources being used in the best possible manner. If energy policy were guided by this "least cost" principle what would we do first? Second? Third? Fourth? And so on.

COMPARATIVE COSTS TO CONSUMERS OF PURCHASING AND CONSERVING ENERGY



SOURCE: Division of Energy, Minnesota Department of Energy, Planning and Development, 1982.

THE MOST BENEFIT FOR THE LEAST COST: KEY TO STUDENT SHEET I

"Comparative Costs to Consumers of Purchasing and Conserving Energy"*

			$
CONSERVATION			
a	-	Thermostat setback	0
b	-	Automatic temperature controls	1.08 - 1.76
c	-	Wall insulation	1.32 - 2.15
d	-	Weatherstripping and caulking	2.17 - 3.56
e	-	Attic insulation to R 48	3.03 - 5.10
f	-	Superinsulated house	3.14 - 5.23
CONVENTIONAL			
g	-	Natural gas	6.36
h	-	Fuel Oil	14.91
i	-	Electricity	15.20
		Coal/Nuclear	
UNCONVENTIONAL			
Substitute Energy Sources			
j	-	Hydro	13.60 - 15.65
k	-	Wind	7.22 - 26.42
l	-	Solar - Passive	2.50 - 6.35
m	-	Solar - Active	24.00 - 25.00
Biomass - Direct Burning			
n	-	Wood and wood residues	2.94 - 17.31
o	-	Animal wastes/Urban wastes	6.14
p	-	Special energy crops/peat	6.14 - 9.71
q	-	Agricultural crop residues	3.80 - 5.71
Biomass - Synthetic Fuels			
r	-	Synthetic gas	4.46 - 28.52
s	-	Ethanol (from biomass)	27.87 - 32.45
t	-	Ethanol (from corn)	35.34 - 38.34
u	-	Methanol	7.05 - 47.67

*These costs include energy efficiency losses during conversion processes.

Answer These Questions:

1. Write down some things you notice about this graph.
2. How are energy costs measured on this graph?
3. How are energy alternatives grouped on this graph?

4. Make a table which lists the conservation measures, conventional energy sources and unconventional energy sources.

5. The figure shows that conservation methods are substantially less - about the same - more (circle one) that the production of any new energy supply. What evidence are you using?

6. On the average, is it cheaper to invest in conservation measures than it is to replace traditional energy supplies? What evidence are you using?

7. Does the analysis presented in the graph show that all conservation measures are cheap? Which ones are less expensive than existing fuels? Which, more expensive?

8. Which is the most expensive conservation measure listed? The least expensive?

9. Tell why you agree or disagree with the following statement. The analysis in this graph shows that the energy prices currently paid by consumers and used by most people in making conservation decisions are much lower than the cost of producing, delivering and using new energy supplies. What evidence are you using?

10. On the average, are the costs of most alternative energy sources competitive with the costs of traditional sources? What evidence are you using?

11. Would you say that the major point of this graph is that conservation measures are by far the most effective way for solving our energy problems? Why or Why not?

THE MOST BENEFIT FOR THE LEAST COST: STUDENT SHEET II

1. Most new homes constructed today will be candidates for energy conservation improvements within 10 years. This need not occur since construction techniques now exist that can almost eliminate the need for energy to heat new homes.

   What opportunity cost is involved here? _____

   _____

   What is the best choice to make? _____

   _____

   Why? _____

   _____

2. An electric utility proposes the construction of a large coal-fired generating plant to meet some projected electricity needs. The drain of dollars from the state will increase to pay for coal severance taxes. (Many coal producing states charge a tax. In some cases it's large.) This will cost the state many jobs because the dollars aren't staying in the state. Because coal is a dirty fuel there will be environmental impacts. Furthermore, there will be a delay in developing renewable energy sources if the plant is built.

   What opportunity cost is involved here? _____

   _____

   What is the best choice to make? _____

   _____

   Why? _____

   The opportunity cost of my decision is _____

   _____

   _____

3. Biomass (plants such as peat, cattails, energy crops, wood, farm crop residues) is one of Minnesota's biggest energy resources. Biomass is a renewable energy resource. Much biomass is currently or potentially more valuable as food or raw materials. Because biomass requires large land area and water there is a great need for careful environmental monitoring. The extent to which using several biomass alternatives would affect the environment is not known.

   What opportunity cost is involved here? _____

   _____

How would you vote on a decision regarding a proposal to develop an ambitious biomass program where the effects of that decision are not clear? I would vote to: _____

The opportunity cost of this decision would be _____

4. Petroleum is the least secure and most expensive energy supply. More than 60% of Minnesota's petroleum consumption is used for transportation. This includes gasoline, diesel fuel and jet fuel use.

   Carpooling and vanpooling offer an effective near-term solution to reduce motor fuel demand.

   What opportunity cost is involved here? _____

   Biomass should be converted to liquid fuels to serve our transportation needs.

   What opportunity cost is involved here? _____

   High school students should be discouraged from driving to and from school.

   What opportunity cost is involved here? _____

   How would you rank order these choices from most preferred (1) to least preferred (3)? The opportunity costs of this ranking would be _____